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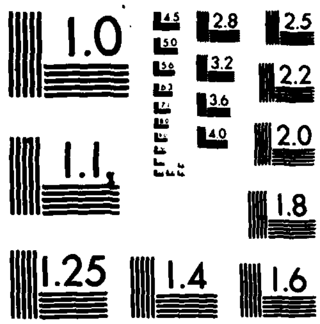

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ANALYSIS OF HUMAN OSTEOLOGICAL REMAINS

MULTI-COUNTY AREAS, NORTH DAKOTA

By

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An osteological analysis of remains discovered by the North Dakota area archeologist over a three-year period (1979-81). Remains exposed as a result of severe shoreline erosion along reservoirs (COE) located in North Dakota.

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ABSTRACT

A minimum number of 16 human skeletons both partial and complete had been recovered during nine salvage operations (labeled Exhibits A - I) ~~by Army Corps personnel~~ along the shores of lakes Bowman-Haley, Sakakawea, and Oahe. Both the human remains and artifactual material contained in the nine exhibits were analyzed by the staff of the Anthropology Department, University of Arkansas under contract to the Omaha District U.S. Army Corps of Engineers. Exhibit A, 32 ME 463 (Lake Sakakawea) is of unknown cultural and temporal association and contained two possible adult males and one possible adult female. The predominant pathology is degenerative arthritis. Craniometric analysis indicates a possible mixed Mandan-Arikara genetic affiliation. Exhibit B (Lake Oahe) is possibly historic Arikara and contains: one male, 30-40 years; one female, 22-29 years; one adult of unknown sex; and one juvenile, 17-19 years. Pathologies include one case of degenerative arthritis and spina bifida. Exhibit C, 32 ME 1 (Lake Oahe) is assigned to the Extended Middle Missouri Tradition and contains one nonhuman incisor. Exhibit D, 32 ME 42 (Lake Sakakawea) is of unknown cultural and temporal affiliation and contains nonhuman mammalian long bone fragments. Exhibit E, 32 BO 30 (Lake Bowman-Haley) is of unknown cultural and temporal affiliation and contains one human adult femur. Exhibit F (Lake Oahe) contains one young adult female who displays cranial deformation resulting from premature suture closure. Craniometric analysis suggests the possibility of an Arikara affiliation. Exhibit G, 32 EM 102 (Lake Oahe) is a Mandan Earth Lodge site and contains an adult skeleton of unknown sex. The major pathology is degenerative arthritis. Exhibit H, 32 SI 3 (Lake Oahe) is assigned to the Extended Middle Missouri Tradition and contains one nearly complete female skeleton over 50 years of

age and one adult mandible. Craniometric analysis indicates a Mandan affiliation. This elderly female displays: senile osteoporosis; degenerative arthritis; spinal osteophytosis; and inflammatory joint disease. Exhibit I (Lake Oahe) is of unknown cultural and temporal association and contains one possible adult male, one possible adult female, one adult of unknown sex, and one five year old child. The only pathology is mild cribra orbitalia in the child. The presence of splintered human long bones suggests the possibility of a massacre at the location of Exhibit I. The major postcranial anomaly found in Exhibits B, F, G, H, and I is retroversion of the left proximal femur and anteversion of the right proximal femur head which is tentatively diagnosed as coxa vara.

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Many individuals and several organizations contributed to the completion of this project. First, we are grateful to the Omaha District Office of the U.S. Army Corps of Engineers for the opportunity to do the analysis, and especially Ms. Becky Otto for her assistance with our problems and her courtesy in providing topographic maps and "In-House" reports. Mr. Howard Thelen of the Omaha Corps Office provided "In-House" reports, site forms, and publications. Mr. John Peterson II of the State Historical Society of North Dakota provided additional site forms, draft reports, and publications. We wish to thank these individuals and organizations. Mr. Richard Berg of the Omaha Corps Office provided valuable advice and assistance for which we are grateful. We also wish to thank Ms. Jane Treat and the typists from the Office of Research and Sponsored Programs, as well as Ms. Betty Martin of the Electron Microscope Facility for their valuable assistance. We also wish to thank the anonymous reviewers whose suggestions improved this report.

The authors wish to dedicate this volume to Dr. George Armelagos.

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INTRODUCTION

Nine collections of American Indian skeletal material retrieved from Federal impoundment shorelines in North Dakota are described in this report. These materials which on occasion include artifacts and other vertebrate faunal remains were salvaged by U.S. Army Corps of Engineers, Omaha District personnel between 1979 and 1981 from Lakes Oahe, Sakakawea and Bowman-Haley. The collections (labeled exhibits "A through I") represent a minimum number of sixteen individuals based on available skeletal remains, that vary from single elements to nearly complete skeletons.

This report, prepared under Purchase Order DACW45-82-M-1681, has a threefold purpose. First, it is to provide a cultural historical framework for these discoveries, to the extent the data allow. Second, it is to document the skeletal remains recovered and place them within a bioarcheological context. Third, it is to underscore the heuristic value of the individual finds and to recommend recovery procedures for others which are expected to be discovered in the future.

The area of these discoveries, especially Lake Oahe, is familiar to anthropologists and the general public of the Dakotas as the most recent homeland of three Indian tribes, the Arikara, Hidatsa and Mandan, who occupied villages along the Missouri River and its tributaries in these two states, and of nomadic groups such as the Sioux who interacted with them. Due to reservoir construction primarily on the Missouri River and its stimulus to archeology in the Dakotas, the prehistory and historic archeology of these northern Plains villagers and nomads is reasonably well known (see Lehmer 1971 for a general review), as is also their bioarcheology (Bass 1964; Hughey 1980; Jantz 1977). Isolated finds such as those considered here have their place in this larger saga. For they represent both an opportunity to test previously held ideas against new data and an obligation to insure that these valuable remains receive the same careful attention as have past discoveries.

Synopsis of Field Operations

No data are available on the times of notification or recovery of exhibits C or D but all others are at least identified to a date of recovery (Table 1). Unpublished descriptions of the recovery of Exhibits A, B, E and H were prepared by Mr. Larry G. Robson, formerly Staff Archeologist, U.S. Army Corps of Engineers, North Dakota Area Office, Riverdale, North Dakota. This synopsis draws primarily upon the information presented by Robson, who was principally responsible for the salvage of the latter 4 exhibits. Figure 1 illustrates the approximate locations of these finds and Table 2 provides available legal descriptions.

Exhibits A and B were salvaged almost immediately after notification of the remains was received by the Corps, respectively, in late July, 1980 and early December, 1979. Recovery of Exhibits F through I came during the months of October and November, 1980 and 1981, while Exhibit E was recovered in May, 1979. With the possible exception of Exhibit A, harsh weather conditions had an adverse affect on salvage operations and generally limited the efforts to collect the skeletal elements. No photographs were taken of exhibits D, G and I. This is doubly unfortunate as no attempt was made to record graphically the layout of the remains and often the actual location was inadequately noted. Thus we are left with virtually no record of the actual context of these exhibits. Excavation of Exhibits A and B, however, did provide limited information on burial context or probable artifact associations. For Exhibit

TABLE 1

Summary of Field Operations for Exhibits A to I.

Exhibit	Date of Discovery or Notification	Date of Recovery	Situation	Photographs*
A	23 July 1980	24 July 1980	Bank erosion	Yes
B	2 November 1979	3-5 December 1979	Bank erosion	Yes
C	N/A	N/A	Pot hunting	Yes
D	N/A	N/A	N/A	No
E	N/A	May 1979	Blowout	Yes
F	N/A	28 October 1981	N/A	Yes
G	N/A	10 October 1980	N/A	No
H	N/A	5 November 1981	Bank erosion	Yes
I	N/A	1 October 1980	N/A	No

* All photographs and color slides are stored at the Riverdale Office of the Omaha District, Corps of Engineers.

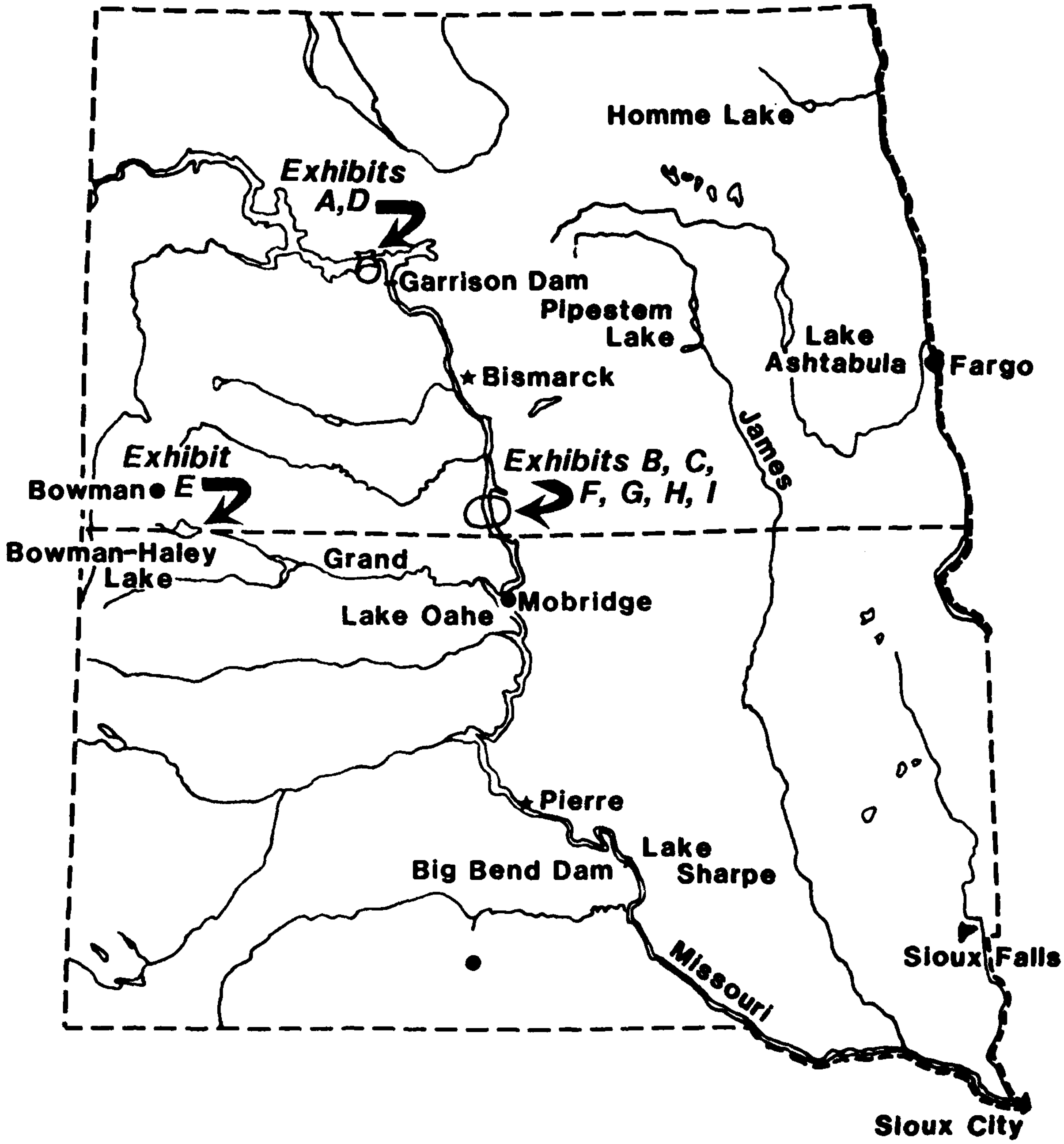

Figure 1. Map of North and South Dakota showing general locations of Exhibits A through I.

TABLE 2

Geographic Locations of Exhibits A to I

Exhibit	Site	Legal Description	County	Lake
A	32ME463	NE1/4, SW1/4, SE1/2, Sec. 33, T147N, R87W	Mercer	Sakakawea
B	Winona Island	N1/2, NW1/4, Sec. 8, T130N, R79W	Emmons	Oahe
C	32EM1, Havens	SW1/4, NE1/4, Sec. 3T, 129N, R79W	Emmons	Oahe
D	32ME42	SW1/4, NE1/4, Sec. 34, T147N R87W	Mercer	Sakakawea
E	32BO30	N1/2, NE1/4, SW1/4, Sec. 13, T129N, R101W	Bowman	Bowman/ Haley
F	Winona Island	N1/2, SE1/4, NW1/4, Sec. 8, T130N, R79W	Emmons	Oahe
G	32EM102	SW1/4, SE1/4, Sec. 17, T130N, R79W	Emmons	Oahe
H	32SI3, Robert Zahn	SE1/4, NE1/4, SE1/4, Sec.9, T120N, R79W	Sioux	Oahe
I	Fort Yates Shoreline	N/A	Sioux	Oahe

A, the human remains were found within a stratified sediment of 7 zones, mainly in levels V and VI, at recorded depths of less than 2 feet below the original beach, but were without artifacts. Exhibit B was a beach surface find of 2 concentrations approximately 13 feet apart. Although salvage was hindered by frozen ground (a torch was used to free bones from the matrix which resulted in their partial burning), screening of the matrix produced a varied assortment of aboriginal and historic trade artifacts. Exhibit H was observed to be a flexed burial, placed on its right side with the head toward the south. Although artifacts were collected from near the burial, Robson regarded them as probably having been deposited "near the burial by wave action" of Lake Oahe from the Robert Zahn site (32SI3). Exhibit F, like Exhibit B, came from the Winona Island shoreline and conceivably could be a vestage of the same cemetery, but this is not proven. There are no artifacts associated with Exhibit F which might possibly resolve this question.

Exhibit B investigations are worth describing in slightly more detail. This was one of the few exhibits to be well photographed and the only one where an attempt was made to screen the matrix for artifact recovery. It is also noteworthy for the length of time between its initial discovery, near Labor Day, and the Corps' notification in November, 1979. A result of this lapse was the possible loss of valuable skeletal material (a rumored presence of 8 human skulls).

Bioarcheological Research in the Northern Plains

Although our general knowledge of Plains physical anthropology is extensive (Hughey 1980), the greatest research effort has been expended in the area of osteology and bioarcheology (Jantz 1977). This emphasis upon bioarcheology can be attributed to three circumstances: 1) extensive landform alterations which required mitigation of many large prehistoric and historic sites; 2) the excellent state of skeletal preservation; and 3) an interest in the area by a number of osteologists as well as financial support for their research (see Bass 1974 and Hughey 1980 for reviews). The research orientation of Plains bioarcheologists has been greatly influenced by the unique historical development of the Plains. Accounts of early explorers and the absence of extensive Native American dislocations enabled the archeologists to assign historic and protohistoric sites to specific ethnic groups. Since large skeletal series of known ethnic affiliation have been available for analysis, bioarcheologists have focused their research efforts on the reconstruction of population-cultural histories, as well as assessing population-genetic affiliations and origins (Bass 1964; Bass et al. 1971; Jantz 1977 among others). Although several data sources have been used in this research, emphasis has been placed upon multivariate statistical analysis of craniometrics.

Some highlights of craniometric research includes reconstruction of population movement; analysis of microevolutionary change; estimation of genetic admixture; and determination of ethnic affiliation. The population movements of the Arikara northward out of Nebraska have been reconstructed and documented by multivariate analysis of craniometrics (Jantz 1973). It has been postulated that changes in Arikara cranial morphology such as reduction in cranial height can be explained by genetic admixture with northern groups including the Mandan (Jantz 1972; 1973, 1977). Recent reanalysis of the same data suggests that these temporal patterns may not be so simply explained (Key and Jantz 1981). Population movements and admixture have been so well documented that cultural events, such as ceramic style changes, have been explained by immigration from neighboring groups (Jantz 1974). Additionally, craniometrics have been used to establish ethnic affiliations of archeological sites when analysis of the cultural data produced ambiguous results (Jantz 1976).

The large well documented skeletal series from the Dakotas have enabled bioarcheologists to conduct sophisticated demographic analyses. High infant mortality, low overall life expectancy, and a declining population observed in the Arikara sample from the Larson site have been attributed to Western diseases (such as smallpox and tuberculosis), as well as to malnutrition, starvation, and warfare (Owsley and Bass 1979). One characteristic of life on the Plains was warfare with frequent destruction of villages and their inhabitants. A useful consequence of this activity is the production of cross sectional samples of a population from a single point in time, which can then be compared to the composite demographic profiles produced by natural mortality (Owsley et al. 1977; Zimmerman et al. 1981). Although a large amount of work is yet to be done, the potential for demographic research in the Plains is considerable.

One interesting aspect of Plains warfare is the widespread practice of scalping and corpse mutilation. These practices are best documented at the Larson (Owsley et al. 1977) and Crow Creek sites (Zimmerman et al. 1981). This very exciting aspect of paleopathology has tended to overshadow other areas of paleopathology such as the interpretation of infectious and degenerative diseases. For example, the incidence of skeletal lesions is well documented at the Leavenworth (Bass et al. 1971) and Crow Creek (Zimmerman et al. 1981) sites, but little interpretive analysis is attempted (Brues 1974). With the exception of thorough analyses of ear and temporal bone diseases by Gregg and co-workers (see Hughey 1980 and Zimmerman et al. 1981 for summary and citations), no synthesis of disease trends on the Plains has been produced. A recent study of tuberculosis among the Arikara suggests that the research orientation is changing and a greater emphasis will be placed upon paleoepidemiological research (Palkovich 1981).

Without a synthetic overview of pathological trends on the Plains, all conclusions are tentative at best. For purposes of this project a short chronological summary is presented. The paleopathological pattern of Archaic peoples throughout North America is fairly uniform and is dominated by extensive osteoarthritis of the major joints, osteophytosis of the spine, and little evidence for infectious lesions of the skeleton (Neuman 1967). Dental caries are rare and dental attrition is heavy. Premortem tooth loss is attributable to extensive attrition. Until further evidence is forthcoming, it must be assumed that the Plains Archaic pattern is similar to that from the Midwest. The post-Archaic pattern on the Plains is characterized by an increase in infectious lesions and a decrease in the frequency of degenerative joint diseases. For example, the Grover Hand site representing the Sonota Complex (A.D. 90-610) has a periostitis rate of 38.5% for tibiae, while osteoarthritis does not appear to be common (Bass and Phenice 1975). Dental attrition is heavy, abscessing and premortem tooth loss is extensive, while dental caries rates are low (Bass and Phenice 1975). The adult male disease rates for the putative Arikara from the Sully Site are as follows: osteoarthritis, 50.0%; periostitis, 16.7%; and trauma, 7.1% (Bass 1964). In contrast, infectious lesions of the skeleton appear to be rare, while osteoarthritis is common among the historic Arikara (Zimmerman et al. 1981). The Arikara dentitions are characterized by heavy attrition, frequent abscessing, and moderate caries rates (e.g., 2 caries per person) (Bass et al. 1971; Hughey 1980).

Hughey, in his 1980 review article of Great Plains Physical Anthropology, enumerates three goals for Plains bioarcheological research. First, reconstruct the patterns of gene flow and migration for the prehistoric and historic cultures of the Plains. Second, measure and interpret changes in the adaptive efficiency of Plains cultures associated with both ecological and cultural change using paleodemography, paleoepidemiology, and nonspecific stress indicators. Third, reconstruct the changes in the bioenergetics of Plains cultures over time using dietary reconstruction and estimation of nutritional adequacy. Ideally, these research goals can be achieved by analysis of large well documented skeletal series. However, small skeletal series and even individual skeletons can contribute to the achievement of these goals by providing insight into the overall variability of the data. The overall research goal of the Multicounty Bioarcheology Project is to analyse the nine exhibits within the framework of Hughey's three bioarcheology research domains. Specifically, where possible the biological data from each exhibit is interpreted in light of the existing knowledge of Plains bioarcheology. Where comparative data are not available, the data sets are presented for the use of future researchers. The methodology (detailed in the next section) for this project was designed specifically to meet the requirements of Hughey's research goals. Prior to the discussion of the bioarcheological contributions of the nine exhibits, each one will be described in detail.

METHODOLOGY

All skeletal and artifactual material representing Exhibits A through I (Osteological Remains, Multi-County Area, North Dakota) arrived at the

Osteology Laboratory of the University of Arkansas packed in three large cartons. This material was packed and shipped from the Omaha District's North Dakota Area Office, Riverdale. Each carton produced one or two large plastic bags each containing osteological and artifactual material individually wrapped as well as a card designating the contents (i.e., "This contains exhibit C, H, B"). Unfortunately more than one exhibit was enclosed in a single bag, while the individual packages were unlabeled. This absence of labeling produced difficulties in sorting out the material into individual exhibits. Some of the material had been previously labeled and was easily assigned, while the remaining material was assigned by matching the material with the following sources of information: 1) labels on some of the individual items; 2) descriptions contained in the scope of work and field reports for exhibits A, B, and H; and 3) the label cards included within the large plastic bags. The resulting assignments provided the best reconciliation with all sources of information.

Since all the material had been previously cleaned only minor cleaning tasks were required. Each bone and artifact was labeled by exhibit designation (i.e., XA) and assigned an individual item number for each bone and artifact (i.e., 132). Two minor variants were used for the bones from exhibit B and all artifacts. In exhibit B the bone "pile" designations were labeled (1 or 2) and bone clusters were given the same number and distinguished by letter (i.e., 41A). Indistinguishable artifacts such as flakes from the same raw material were assigned the same number and distinguished by a letter. In summary, each individual bone and artifact received a unique code designation using a combination of numbers and letters (i.e., XB 1 #41A).

Each exhibit was arranged on a table in anatomicial position. Those exhibits containing multiple individuals were sorted by individual bones (i.e., right femora). Bones were then paired by side and matched for morphology, size, sex, and age characteristics which were used to reconstruct minimum numbers of individuals. Where possible bones were matched across joints to produce partially reconstructed skeletons. This procedure resulted in the factoring out of discrete individuals and a residue of unassignable skeletal elements. All further analysis was conducted using the reconstructed individuals and miscellaneous skeletal elements.

Each exhibit was inventoried by identifying the anatomical position of each item number. All skeletal measurements were taken using standard osteometric instruments following the procedures and definitions compiled by Bass (1971). Certain nonstandard cranial measurements were taken for use in determining cultural affiliation using the criteria designated by Jantz (1976; 1977). In addition, the study of femoral torsion required the use of measurements of the proximal femur defined by Steindler (1970), Hershkovitz et al. (1982), and VanGerven (1971).

All artifactual material were arranged by functional category (i.e., pottery) and described by cultural affiliation, raw material and artifact type. Where appropriate all artifacts were measured (i.e., length, width, thickness) and weighed, using metric sliding calipers and a Ohaus triple beam balance. All metal artifacts were radiographed to reveal the unaltered artifact form as well as to clarify manufacturing techniques. All artifacts were "smoked" with Ammonium Chloride and photographed with 35mm Kodak Panatomic film and a Pentax SLR equipped with a close-up lense. Color slides were made of selected materials.

Sex designations were determined for individual skeletons, functional complexes (i.e., leg), and individual skeletal elements using a modification of the procedures developed by Acsadi and Nemeskeri (1970). Each morphological and metric feature useful in sex determination was scored on a scale of +2 (hypermasculine) to -2 (hyperfeminine) and a weighted mean score was calculated to assign sex for individual skeletons. Possible sex designations were made for isolated bones, although the reliability of these designations is low. All criteria used for scoring were derived from the published literature (Acsadi and Nemeskeri 1970; Bass 1971; Brothwell 1972; Krogman 1962; Ubelaker 1978) and standardized by comparison to Plains osteometric data (Bass et al. 1971; Loveland 1980; Zimmerman et al. 1981). No sex determination was attempted on individuals younger than 16 years of age.

Age determination of children employed dental development standards (Demirjian and Levesque 1980; Moorress et al. 1963a; 1963b; Schour and Massler 1945; Sundick 1972). Juveniles were aged by epiphyseal closure using published standards (Bass 1971; Brothwell 1972; Krogman 1962). Adults were aged by degenerative changes in the pubic symphysis using models for both males (McKern and Stewart 1957) and females (Gilbert and McKern 1973). Because these two techniques are most reliable in the younger age categories, the Todd technique, which consists of both photographs and written descriptions of the pubic standards, was also employed to prevent systematic underestimation of age (Todd 1920). In addition, a technique based on the degenerative changes in the sacral surface of the ilium was also employed (Lovejoy, personel communication). The technique consists of a description and photograph for each five year adult age category. An age assignment was made only after all the above techniques were reconciled.

All bones were examined macroscopically and with the aid of a stereomicroscope for identification of pathological lesions. Each lesion was diagnosed where possible using comparative collections, the standard paleopathology literature (e.g., Brothwell and Sandison 1967; Buikstra 1981; Ortner and Putschar 1981; Steinbock 1976), and the regional osteological literature (e.g., Bass 1964; Bass et al. 1971; Palkovich 1981; Steele et al. 1965; Zimmerman et al. 1981). Each lesion was described and photographed with a Polaroid MP4 camera with Polaroid +/- 665 film, prior to being radiographed using standard clinical procedures and film. All lesions were independently diagnosed using clinical radiographic interpretation. Final diagnosis resulted from mutual concordance of both the clinical and paleopathological interpretations.

The partial dentitions and teeth were inventoried and scored for caries, dental attrition, abscessing, calculus deposits, agenesis, antemortem exfoliation, and dental morphology. Caries were identified by penetration of the enamel surface by a sharp dental explorer and recorded by tooth surface following the procedures of Moore and Corbett (1971). Quantification of dental attrition employed the Scott (1979) system which scores each molar occlusal surface quadrant from one to ten on the basis of the proportional area of enamel wear facets and remaining enamel, when the dentin is exposed. The total score for each molar (which can range between 0 and 40) was determined by summing the scores of the four quadrants. Molar attrition was also scored using the Murphy (1959) system. This method requires matching the amount of dentin exposure to standardized drawings which have been assigned scores between zero and nine.

Abscesses were scored by the presence of observable drainage passages in the mandible and maxilla. Antemortem tooth loss was differentiated from postmortem loss by the presence of alveolar remodeling activity.

As a complement to the attrition analysis, the molar surfaces were observed with the scanning electron microscope (S.E.M.) (Rose et al. 1981;

Rose 1981; Ryan 1979; Walker et al. 1978). Three molars were selected for examination and cleaned in a sonic cleaner with 95% ethanol. The crowns were removed from their roots, mounted on aluminum stubs, and coated with 17.3 nanometers of gold (P.I.I. sputtering system). The mesio-lingual cusp was marked and the specimen mounted in an I.S.I. 60 scanning electron microscope set at a beam angle of 15^0 and a voltage of 30KV. Each mesiolingual cusp was photographed (Polaroid type 55 +/-film) at low magnifications (i.e., 15-20x). The surface of each cusp was examined at 500 magnifications and two to four micrographs were taken at 1500 magnifications to represent the surface topography of the cusp. The enamel surface topography was described and compared to similar micrographs from other skeletal series.

The frequency of macroscopic hypoplasias were collected from all available teeth using the criteria and procedures of Goodman and co-workers (1980). The distance of each hypoplasia from the cementoenamel junctions was measured with Helios dial calipers and converted to their age of incidence using a dental growth chart (Goodman et al. 1980). Hypoplasias form during the growth and development of the enamel and thus can be used to calculate the specific age during childhood when stress occurred. A similar indicator of childhood stress are growth arrest lines (i.e., Harris lines) in long bones. Radiographs of all tibiae were obtained using standard clinical procedures and film. The age of incidence for each Harris line was calculated using the procedures established by Clarke (1982).

Genetic variation between and within skeletal series can be measured using non-metric (i.e., epigenetic) skeletal traits. A total of 31 cranial and nine postcranial non-metric skeletal traits were scored using the system employed by Buikstra (1976; personal communication). This system scores each trait as not observable, absent, or present in one to four possible variants. The sample sizes of these exhibits are too small for the analysis of non-metric skeletal traits, but the data are reported in Table 22 for the use of future researchers. The extensive attrition of the few remaining teeth prevented the collection of dental morphology data.

Cultural affiliation was determined by craniometric analysis. Jantz (1976) used discriminant function multivariate statistics to develop formulae for distinguishing Mandan and Arikara crania using 12 measurements. The resulting discriminant function coefficients and sectioning points were published and can be used to assign crania to either of the two ethnic groups. This procedure assumes that the crania belongs to one of the two groups (and not some third unknown group) and does not take into account any microevolutionary change or population admixture which may have occurred over time (Key and Jantz 1981). For example, Jantz (1977) reports that discriminant formulae progressively misclassify Arikara as Mandan over time due to possible Mandan gene flow. Using the auricular mean height index, Jantz (1977) demonstrated that although there was a regular trend in the reduction of cranial height, the Northern Plains Mandan are remarkably homogeneous. Although the Mandan and their prehistoric predecessors are not well known, these data suggest that the auricular height index could be used to identify Mandan crania at least prior to 1700 A.D. If the auricular height index [auricular height index = (length + breadth x $1/2$) x 100] falls at 70 +/-2, then the cranium is probably Mandan or proto-Mandan (Jantz 1977). If judiciously employed, these two techniques can be used to tentatively assign crania to either Arikara or Mandan affiliation. The Mandan and Hidatsa are not distinguishable with craniometrics and assignment to the Mandan cannot exclude a possible Hidatsa affiliation. In this report all Mandan assignments must be considered Mandan or Hidatsa.

EXHIBIT DESCRIPTIONS

Exhibit A | 32 ME 463 | Beulah Bay Burial

The human skeletal material labeled Exhibit A was found eroding out of the beach in the Beulah Bay area of Lake Sakakawea. Army Corps of Engineer personnel excavated the skeletal material, which was confined to a .4' thick layer approximately 1.6' beneath the original beach surface (see Robson 1980 for additional information). No artifacts were recovered in association with the skeletal material and no cultural affiliation or data could be established. The burial is a secondary reburial and Robson (North Dakota Site Form) suggests the possibility of a Woodland affiliation. It should be emphasized that this exhibit cannot be assigned to either a cultural or temporal context, without which bioarcheological comparisons and generalizations are impossible to make.

A minimum number of three individuals are represented by three distinct sets of humerus scapula articulations. All the miscellaneous bones are consistent with this determination and suggest that no more than three individuals are present in this collection. All three individuals are adults (twenty years and older) and at least one is a middle to old adult. The size and robusticity of all available bones suggest the presence of at least two possible males and one possible female. The predominant pathological condition observed in this collection is degenerative arthritis. Craniometric analysis of the one skull suggests a historic derivation from a mixed Mandan-Arikara background.

Individual 1 is represented by a left scapula (XA 92), a left humerus (XA 85), and left ulna (XA 81), a left radius (XA 134) and a left clavicle (XA

93). Epiphysial closure of the clavicle indicates an age at death in excess of 25 years. Bone robusticity, particularly the humerus, suggests a male designation. The clavicular facet of the scapula and corresponding acromion articular surface of the clavicle exhibit lytic lesions. The sternal end of the clavicle displays marginal hypertrophy and the entire surface is highly porous. The glenoid fossa of the scapula displays areas of irregular marginal lipping. The olecranon fossa of the ulna is also lipped. The rim of the radius head is porous, as is the rim of the capitulum. The suggested diagnosis for this lesion complex is degenerative arthritis involving the sternoclavicular, acromioclavicular, shoulder, and elbow joints. Postcranial measurements are tabluated in Table 3.

Individual 2 is represented by a right humerus (XA 80) and a right scapula (XA 87). Epiphesial union of the scapula indicates an age at death greater than 20 years, while bone robusticity suggests a possible male designation. The periphery of the humerus head displays osseous hypertrophy, porosity, and one small area of macroporosity. The rim of the capitulum displays osseous hypertrophy and porosity. The clavicular facet of the scapula is enlarged, while the entire surface shows lytic destruction. The glenoid fossa exhibits slight irregular marginal lipping. The lesion complex is suggestive of degenerative arthritis involving the acromioclavicular, shoulder, and elbow joints. A possible osteoid osteoma is located between the lesser tuberosity and the humerus head.

Individual 3 is represented by a left scapula (XA 135), a left humerus (XA 91), and left (XA 89) and right (XA 92) clavicles. Epiphesial union of the clavicles suggests an age at death in excess of 25 years, while bone robusticity indicates a possible female. The clavicular facet of the scapula and acromial articular surfaces of the clavicles are enlarged and exhibit extensive lytic destruction. The sternal ends of both clavicles display osseous hypertrophy with generalized porosity and macroporosity of the central areas. The humerus head (Plate 1) shows microporosity of the articular margins with osseous hypertrophy. The greater tuberosity is enlarged by exostosis. This lesion complex is diagnosed as degenerative arthritis involving the sterno-clavicular, acromioclavicular, and shoulder joints which is more advanced than individuals one and two.

Miscellaneous bones assignable to any of the preceding individuals are discussed as individual bones. The cranium (XA 160-4) and the right half of the corresponding mandible (XA 160-3) are assigned an age at death of middle to old adult (45+ years) using the pattern of suture closure. Robusticity and shape characteristics of the cranium suggest a male designation. The maxillary alveolar bone is greatly resorbed due to the loss of all teeth except the right third molar, left second premolar, and first molar (Plate 2). Similarly the right mandible shows excessive alveolar resorption with the loss of all teeth except the canine, first and second molars. All remaining teeth are heavily worn, in some cases below the cementoenamel junction (Plate 3). A total of five abscesses were observed and attributed to pulp exposure from rapid dental attrition. No caries were observed. Additional dental data are presented in Table 4.

The low magnification (19x) scanning electron micrograph of the right third maxillary molar shows extensive large striations and no compression fractures (Plate 4). A high magnification (1500x) micrograph shows striations produced by cleaning and curation and illustrates that utmost care must be taken while cleaning teeth (Plate 5). Additionally, the cranium should never

TABLE 3

Postcranial Measurements in Centemeters for Exhibit A.

	Individual 1		Individual 2		Individual 3		Miscellaneous			
	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Scapula				XA87	XA135					
Max. Length	-	-	-	17.1	15.2	-				
Max. Breadth	-	-	-	10.5	10.4					
Clavicle	XA93				XA89	XA92				
Max. Length	15.5	-	-	-	15.2	15.2				
Circum. Midshaft	3.6	-	-	-	3.1	3.2				
Humerus	XA85			XA80	XA91					
Max. Length	30.8	-	-	31.8	29.4	-				
Max. Diam. Midshaft	2.6	-	-	2.7	2.6	-				
Min. Diam. Midshaft	1.9			1.9	2.1	-				
Circum. Midshaft	6.7	-	-	7.2	6.2	-				
Max. Diam. Head	4.8	-	-	4.9	4.3	-				
Min. Diam. Head	4.4	-	-	4.5	4.0	-				
Least Circum. Shaft	6.7	-	-	7.2	5.9	-				
Radius										
Max. Length	24.7	-								
Ulna										
Max. Length	26.0	-	-	-	-	-				
Phys. Length	23.2	-	-	-	-	-				
Femur								XA83		XA86
Max. Length								-		
Physio. Length								-		
Circum. Midshaft								8.6		9.0
Subtroch. A/P Diam.								2.3		3.0
Subtroch. M/L Diam.								3.2		3.7
Diam. Midshaft								3.0		3.0
Fibula							XA90			
Max. Length							35.8			

TABLE 4

Dental Data for Exhibit A

	P/D	Pres	Erup.	Alveo.	Calcu.	Carie	Abscess	Wear	
Maxillary	XA 160-4							Murphy	Scott
${}^3M$	X	2A	1	4	X	X	1	X	X
${}^2M$	P	1A	1	4	1	1	1	9	38
${}^1M$	X	2A	1	4	X	X	1	X	X
${}^4P$	P	1A	1	4	1	1	1		
${}^3P$	X	2A	1	4	X	X	1		
C	X	2A	1	4	X	X	1		
${}^2I$	X	2A	1	4	X	X	3		
${}^1I$	X	2A	1	4	X	X	1		
I^1	X	2A	1	4	X	X	1		
I^2	X	2A	1	4	X	X	1		
C	X	2A	1	4	X	X	3		
P^3	X	2A	1	4	X	X	2		
P^4	X	2A	1	4	X	X	3		
M^1	X	2A	1	4	X	X	1	X	X
M^2	X	2A	1	4	X	X	4	X	X
M^3	P	1A	1	4	2	1	1	5	25
Mandibular	XA 160-3								
${}_3M$	X	2A	1	4	X	X	1	X	X
${}_2M$	P	1A	1	3	4	1	1	8	34
${}_1M$	P	1A	1	4	2	1	4	9	28
${}_4P$	X	3A	1	4	X	X	1		
${}_3P$	X	3A	1	4	X	X	2		
C	P	1A	1	4	2	1	1		
${}_2I$	X	3A	1	X	X	X	1		
${}_1I$	X	3A	1	X	X	X	1		
I_1	X	X	X	X	X	X	X		
I_2	X	X	X	X	X	X	X		
C	X	X	X	X	X	X	X		
P_3	X	X	X	X	X	X	X		
P_4	X	X	X	X	X	X	X		
M_1	X	X	X	X	X	X	X	X	X
M_1	X	X	X	X	X	X	X	X	X
M_3	X	X	X	X	X	X	X	X	X

Key:
(1) X = Unobservable
(2) P = Permanent, D = Deciduous
(3) 1A = Present
2A = Absent Ante-mortem
3A = Absent Post-mortem
(4) Eruption
5 = *Completely Erupted*
(5) Alveolar Resorption
3 = Moderate 3-5 mm.
4 = Severe: More than 5 mm.
(6) Calculus Deposit
1 = None
2 = Slight: Discrete Areas
(7) Carie
1 = None
(8) Abscess Presence and Size
1 = None
2 = Small 1-3 mm Diam.
3 = Medium 3-5 mm Diam.
4 = Larger than 5 mm Diam.

TABLE 5

Cranial Measurements for Exhibits A, F, H and I in Centimeters

	EXHIBIT A		EXHIBIT F	EXHIBIT H		EXHIBIT I
Cranium	XA160-4	XA160-3	XF-79	XH-243	XH-241	XI-234
Maximum Length	18.9		17.9	18.2		16.9
Maximum Breadth	14.6		14.8	12.7		-
Maximum Height	12.0		12.2	10.8		-
Basion-Bregma	13.7		13.1	13.0		-
Auricular Height	11.9		12.2	11.0		-
Endobasion-Nasion	10.7		10.1	9.6		-
Endobasion-Prosthion	10.0		9.9	9.2		-
Minimal Frontal Breadth	9.9		9.2	8.7		8.6
Upper Facial Height	7.4		6.9	6.7		5.5
Bizygomatic Breadth	14.8		13.7	12.7		-
Nasal Height	5.6		4.6	5.1		4.0
Nasal Breadth	2.5		2.5	2.3		1.9
Orbital Height	3.2		3.5	3.3		3.6
Orbital Breadth	4.6		4.3	3.9		3.0
Biorbital Breadth	9.9		9.9	9.2		8.1
Nasion-Alviolare	7.4		6.85	6.7		5.5
Maxillo-Alveolar Brd.	-		6.6	4.9		-
Maxillo-Alveolar Lgth.	5.4		5.1	-		-
Palatal Length	-		4.1	4.1		3.6
Palatal Breadth	-		3.4	3.4		2.5
Height of Ascending Ramus		6.1	-	-	5.8	-
Height of Mandibular Symphysis	-	-	-	-	3.5	-
Gonial Angle	-	-	-	-	-	-
Mandibular Length		-	-	-	-	-

be placed teeth down on a table. These striations were caused by this practice. A micrograph (1500x) (Plate 6) of the undamaged enamel shows numerous large sharp cross-hatched striations without evidence of polishing. This pattern is typical of southeastern groups who eat a course diet and use stone grinding implements. A low magnification (20x) micrograph of the heavily worn mandibular second molar again shows the numerous large striations (Plate 7) observed on the maxillary dentitions. The large striations in a cross-hatch pattern are again observable at high magnification (Plate 8). This micropattern suggests the consumption of a coarse diet with little vegetable fiber, prepared on stone implements.

Both tempero-mandibular joints exhibit extensive degenerative changes. The left articular tubercle exhibits a lytic lesion, while both the right articular tubercle and mandibular condyle show marginal hypertrophy. The surface of the mandibular condyle displays both proliferative reaction and mechanical abrasion (i.e., eburnation). These indicators of tempero-mandibular joint disfunction can be attributed to large masticatory forces (evidenced by extensive dental attrition) and malocclusion resulting from extensive tooth loss. Both parietals show localized thinning up to 1.5 cm in diameter, which are pachionian granulations. Hypoplasias could not be observed due to extensive dental attrition.

All twelve measurements, used by Jantz (1976) for discriminant function analysis, were obtained from this cranium (Plates 9 and 10; Table 5). A missing piece of bone required the bizygomatic breadth to be estimated, although the possible error is only +/- one millimeter. The male discriminant formula produced a score of -0.076 which is just below the sectioning point (i.e., -0.029) into the Arikara range. Using Jantz' (1976) methodology this skull has a probability of 0.13 of being Arikara and a 0.01 probability of being Mandan. Using the auricular height index of this skull (71.0) and the distribution of this index within the Plains as published by Jantz (1977), this skull has a good chance of being one of the following depending upon the time of burial: Mandan (historic); North Dakota Coalescent (1600-1800 A.D.); or Northern Plains Archaic and Woodland (>1000 A.D.). It must be kept in mind that these techniques can only be used to assign a cranium to ethnic groups which are already known. When Jantz (1976) published his discriminant function formulae there were few available Mandan crania and thus the statistics are not as reliable as they could be. Additional studies indicate temporal changes in cranial morphology (Jantz 1972; 1973; Key and Jantz 1981), which add the requirement of precise chronological data before a cranium can be assigned a cultural affiliation. The obvious difference in the results of these two techniques must be resolved.

The auricular height index for proto-Mandan and Mandan is stable over time, while it slowly declines for the proto-Arikara (Jantz 1976). Thus if the discriminant function formula had indicated Mandan affiliation then the skull could have come from any of the previously mentioned time periods. However, during the historic period the auricular height indicies of both the Mandan and Arikara merge. A similar process occurs for the entire craniometric complex, where during historic times the discriminant function formulae do not reliably discriminate Arikara and Mandan (Jantz 1972; 1973). Thus the ambiguity of the ethnic affiliation suggests that this cranium dates to the historic period, where gene flow has obscured the distinction between the Mandan and Arikara. This conclusion of course assumes that the cranium does not derive from some craniometrically unknown group such as the Sioux.

The size and progressive nature of the degenerative lesions suggest that the ten vertebrae belong to the same individual with a minimum age of death of

20 years. The axis (XA 132) and third cervical (XA 103) vertebra articulate well and display marginal lipping of the articular facets. A fifth cervical vertebra (XA 100) displays advanced marginal lipping of the right and left inferior articular surfaces, and eburnation and porosity of the right inferior articulation. Both the superior and inferior body surfaces display osteoporosis. A seventh cervical (XA 106) and a first thoracic (XA 102) articulate well. The inferior articular surfaces of XA 106 and the corresponding superior facets of XA 102 display marginal lipping. The inferior costal pits of XA 102 show lytic degeneration. Three thoracic vertebrae (XA 105; XA 104, XA 130) all show marginal lipping and porosity of the articular facets, as well as hypertrophy and porosity of the costal pits. One thoracic (XA 131) and the thoracic 12 vertebra (XA 160) display osteoporotic bodies with collapsed surfaces indicating a herniated disk (Plate 11). Both the costal pits and pits on the transverse processes of XA 131 are porous presenting a coral-like appearance.

Twenty five rib fragments are present, but their fragmented condition makes it impossible to determine the number of individuals represented. The developmental condition of the ribs indicates that they are from an adult in excess of 24 years of age. Fifteen left rib fragments include: XA 96; XA 97; XA 98; XA 137; XA 138; XA 140; XA 141; XA 142; XA 143; XA 144; XA 145; XA 150; XA 151; XA 153; and XA 154. Six right rib fragments include: XA 94; XA 95; XA 139; XA 147; XA 152; and XA 155. Four unidentifiable rib fragments include: XA 144; XA 146; XA 149; and XA 160-1. All ribs with articular facets exhibit porous surfaces, enlarged heads, and lipping. This age related pathological condition corresponds to the lesions observed on the corresponding vertebrae described above.

A minimum of one individual is represented by hand bones which include: a right pisiform (XA 128); right lesser multangular (XA 127); left first metacarpal (XA 122); left fifth metacarpal (XA 133); three right first phalanges (XA 124; XA 119; XA 117); four right second phalanges (XA 111; XA 112; XA 114; XA 116); and three right third phalanges (XA 110; XA 126; XA 127). The right lesser multangular (XA 127) exhibits a small (2.5mm) smooth walled resorptive lesion.

A minimum of two individuals are represented by foot bones as indicated by the size disparity between the two naviculars. The following bones of the foot are present: left calcaneous (XA 84); right talus (XA 82); left cuboid (XA 160-2); left navicular (XA 156); right navicular (XA 108); left fifth metatarsal (XA 121); three first phalanges (XA 116; XA 120; XA 125); one second phalange (XA 109); and one third phalange (XA 118).

The development of the linea aspera from two partial right femoral shafts (XA 83; XA 86) suggests that they belong to two distinct adult males. The condyles and patellar facet of one femur (XA 86) are marginally lipped with marked hypertrophic changes along the lateral margins of the condyles. These lesions suggest degenerative arthritis.

One adult left fibula (XA 90) displays a hyperdeveloped head, while another right fibula (XA 88) shows no pathologies or age and sex indicators.

Exhibit B Winona Island Burial.

All components of this exhibit were either collected from the surface or excavated from the top few inches of soil by Corps personnel (Robson 1979). The skeletal material resting on the surface appeared to be in two concentrations approximately four meters apart (Plate 12). The skeletal remains were collected in the two concentrations (labeled XB1 and XB2) as well as scattered material in the surrounding area (labeled XB3). The history of the discovery and excavation of the site suggests that considerable material especially crania may have been removed by "collectors" or natural phenomena prior to excavation (Robson 1979). In addition, since the skeletal material was exposed we cannot be certain whether the observed skeletal articulations are aboriginal or modern (Plate 13). This situation presented considerable difficulty in the laboratory during skeletal reconstruction and the absence of crania prevented the determination of ethnic affiliation.

Exhibit B produced a considerable quantity of artifactual material made of stone, bone, iron, lead, ceramic, and shell. Although no stratigraphic or horizontal data were provided for the artifacts, their great quantity makes it probable that the majority are grave goods. All artifacts are enumerated and described in Table 6, while the quantitative characteristics are listed in Table 7. The lithic material consistes of flakes and tool fragments, none of which are diagnostic. The mammal bone represents one or more large animals most likely Bison, although none of the fragments are diagnostic. In contrast, the artifacts of glass, iron, and lead are chronologically diagnostic.

The Euro-American artifacts include several categories which are chronologically sensitive. The spun glass beads are commonly found with Plains Historic Indian burials, but have a long, if not indeterminate period of use beginning with the early eighteenth century. The nearby Arikara Leavenworth Site cemetery, dating to circa 1803 and 1832, has nearly identical seed or pony beads as well as a larger assortment of decorated beads, iron, brass, lead artifacts and items of bone and stone (Bass et al. 1971). Exhibit B nails seen on radiographs are all rectangular and appear to be machine cut.

They do have irregular shaped heads, which is a diagnostic feature of early headed machine cut nails, produced between circa 1815 and 1839 (Nelson 1968). The lead bullet is probably a .57 caliber musket ball, not unusual for the mid-eighteen hundreds military issue. Based on these data, we estimate that the time of interment was between A.D. 1815 and the 1850's. This assumes that the porcelain pitcher handle, which probably dates after 1850, is not a burial association. In the event that it is a piece of mortuary furniture, then Exhibit B post-dates 1850. Our bias in this matter is to favor the earlier time frame as the more likely possibility because of the Leavenworth Site data. These data suggest an ethnic affiliation of Arikara, in light of historic distribution (Lehmer 1971: Figure III), but groups such as the Yanktonais or Cheyenne cannot be ruled out.

A minimum of four individuals are represented by four sets of femora. Concentration 1 contains the following three individuals: a 22-29 year old female; a 17-19 year old of unknown sex; and a 30-40 year old male. The predominant pathologies include degenerative arthritis, spina bifida, and abnormal femoral torsion. Concentration two contains one adult of unknown sex and age.

Concentration one, Individual 1 consists of the following skeletal elements: right innominate (XA 38B); left innominate (XB1 38A); right femur (XB1 41A). The postcranial metric data are listed in Table 8. The pelvis indicates that this individual is a female aged between 22 and 29 years. Two large exostoses exhibiting macropitting and osteoporosis are located on the iliac tuberosity of the right innominate. One is located just superior to the auricular surface and the other just inferior to the posterior superior iliac spine. Both iliac fossae exhibit areas of abnormal thinning of approximately two by three centimeters in area. Both femora display abnormal torsion of the

TABLE 6

Artifact Descriptions for Exhibit B

161 A: Biface of Knife River Flint; Plate 14.

161 B: Biface of Knife River Flint; flake blank.

161 C: Biface of Knife River Flint; flake blank; Plate 15.

162 A: Flake of Plate Calcedony.

162 B: Flake of Plate Calcedony.

163 A: Flake of Tongue River Silicified Sediment.

163 B: Flake of Tongue River Silicified Sediment.

164 : Flake of white chert.

165 A-G: Seven flakes of Knife River Flint; highly patinated.

165 H: Biface of Knife River Flint; highly patinated.

165 I-K: Three flakes of Knife River Flint; highly patinated.

165 L: Proximal biface fragment of Knife River Flint; highly patinated.

165 M: Flake of Knife River Flint, highly patinated.

166 A and C: Distal humerus of large mammal; water worn; evidence of tool use.

166 D: Distal medapodial or phalange of large mammal; water worn; split longitudinally.

166 E: Third phalange of large mammal.

166 F: Vertebra of large mammal.

166 G: Proximal fragment of possible ulna from large mammal.

166 H: Distal tibia; large mammal; water worn.

166 I: Vertebra; large mammal; water worn.

167 : Eighteen fragments of split mammal bone.

168 : Burned split bone fragment; mammal bone.

169 : Crawfish exoskeleton and miscellaneous animal bone.

170 : Bead; dentalium shell, ground on one end only; Plate 16.

TABLE 6
(Con't)

Artifact Descriptions for Exhibit B

171	:	Simple stamped body sherd; Plate 17.
172	:	Two circular milk glass buttons; Plate 18.
173	:	Four fragments of an iron plate; Plate 19.
174	:	Nine rectangular headed nails; Plate 20.
175	:	Iron harness buckle; Plate 21.
176	:	Lead, round, black powder, projectile; 57 caliber.
177	:	Two white spun glass seed beads.
178	:	Three black spun glass beads; Plate 22.
179	:	Six turquoise green spun glass beads; Plate 23.
180	:	Four indigo blue spun glass seed beads; Plate 24.
181	:	Eighteen yellow spun glass seed beads; Plate 25.
182	:	Sixteen pink spun glass seed beads; Plate 26.
183	:	Two hundred and sixty two turquoise blue glass seed beads; Plate 27.
184	:	Ten royal blue glass seed beads; Plate 28.
185	:	Twenty one white spun glass seed beads; Plate 29.
185	:	Six white spun glass seed beads; large.
185-1	:	White glaze ceramic handle; gold flecked, not salt glazed; Plate 30.

TABLE 7

Metric Characteristics of Artifactual Material For
Exhibits B, D, E, G, and H

Exhibit	No.	Length mm.	Width mm.	Thickness mm.	Weight gm.	N
B	161 A	80.6	72.3	20.0	152.6	1
B	161 B	72.1	40.3	10.4	36.5	1
B	161 C	96.0	64.5	13.0	92.3	1
B	162 A				1.3	1
B	162 B				0.7	1
B	163 A				27.6	1
B	163 B				29.1	1
B	164				5.6	1
B	165 A				4.0	1
B	165 B				1.7	1
B	165 C				4.3	1
B	165 D				2.5	1
B	165 E				0.8	1
B	165 F				1.6	1
B	165 G				2.8	1
B	165 H	25.7	23.7	11.1	7.3	1
B	165 I				6.8	1
B	165 J				1.1	1
B	165 K				2.8	1
B	165 L		30.1	16.8	6.3	1
B	165 M				2.3	1
B	166 A	93.0	39.9	58.6	95.8	1
B	166 C				57.7	1
B	166 D				6.5	1
B	166 E	67.1	24.4	39.4	20.7	1
B	166 F				1.3	1
B	166 G				1.1	1
B	166 H				12.6	1
B	166 I				2.5	1
B	167				156.8	18
B	168				0.8	1
B	169				3.6	1
B	170	28.0	4.5	4.5	0.2	
B	171	20.6	19.5	4.1		1
B	172	13.3	13.3	3.7		
B	172	10.9	10.9	3.4		1
B	173				4.4	4
B	174					9
B	175		29.4	8.4		1
B	176	15.1	14.4	14.6	6.5	1
B	177	1.7	1.7	1.4		2*
B	178	9.8	9.6	6.2	2.3	3*
B	179	1.9	1.9	1.1		6*
B	180	1.8	1.8	1.0		4*

* largest measured.

TABLE 7
(Con't)

Metric Characteristics of Artifactual Material For
Exhibits B, D, E, G, and H

Exhibit	No.	Length mm.	Width mm.	Thickness mm.	Weight gm.	N
B	181	1.9	1.9	1.3		18*
B	182	2.1	2.1	1.3		16*
B	183	2.1	2.1	1.3	2.1	262*
B	184	2.0	2.0	1.0		10*
B	185	2.1	2.1	1.0		21*
B	185	3.4	3.4	2.6		6*
B	185-1	93.5	16.5	9.9	33.5	1
D	53	106.2	62.8	24.3	85.3	1
D	54				75.7	1
D	55				5.3	1
D	56	103.9	61.4	39.8	96.4	1
D	57				0.9	1
D	58				1.2	1
D	59				10.0	1
D	60	57.8	35.3	30.2	92.2	1
D	61 A	20.2	14.4	4.9	1.5	1
D	61 B		33.3	8.4	11.6	1
D	61				22.9	4
E	66	50.2	50.0	25.0	73.5	1
E	67				3.5	1
E	68				6.0	1
E	69				15.1	1
E	70				23.6	1
E	71				4.0	1
E	72				27.1	1
E	73				3.7	1
E	74				7.4	1
E	75				30.2	1
G	43		21.7	14.6	28.3	1
G	50				2.6	1
G	51				2.4	1
H	308		34.3	10.5	12.8	1
H	309	104.0	91.4	44.0	193.8	1
H	310	158.0	34.8	12.6	29.4	1
H	311	37.0	55.4	7.8	15.3	1
H	312	39.0	36.4	-	4.0	1
H	313	46.0	74.0	6.1	26.3	1
H	314	42.0	35.0	9.5	11.2	1
H	315**				0.7	1
H	316**				0.5	1
H	317	44.0	57.7	6.0	25.8	1

* largest measured.
**too fragmentary.

TABLE 7
(Con't)

Metric Characteristics of Artifactual Material For
Exhibits B, D, E, G, and H

Exhibit	No.	Length mm.	Width mm.	Thickness mm.	Weight gm.	N
H	318	67.0	54.4	5.4	24.2	1
H	319	63.0	80.0	9.7	63.3	1
H	320	62.0	61.5	7.5	38.3	1
H	321	45.5	32.5	7.0	11.8	1
H	322	39.0	61.5	8.4	36.5	1
H	323	35.0	28.0	6.7	9.4	1

head area in relationship to the shaft (Table 9). The left has extreme retroversion (10^0), while the right has extreme anteversion (39^0) (Plate 31). The greater trochanter of the left femur is located more superiorly than normal, which would reduce the range of leg abduction (Steindler 1970). The posterior surface of the right femur head exhibits eburnation.

Concentration one, Individual 2 consists of the following skeletal components: right femur (XB1 39C); left femur (XB1 39D); and a right tibia (XB1 39E). Using age and morphology the following elements have been assigned to this individual: left tibia (XB1 41B); left radius (XB1 39A); right ulna (XB1 39B); left rib (XB1 25) and three right ribs (XB1 31, 32, and 33). This individual was 17 to 19 years old at the time of death. Although the linea aspera is hyperfeminine and the bones are gracile, sex determination could not be made due to the young age. The femora exhibit the same torsion phenomenon as Individual 1 (Plate 32). The tibiae are scorched and blackened from the torch used in excavation from the frost zone (Robson 1979).

Concentration one, Individual three consists of the following skeletal elements: right innominate (XB1 40E); left innominate (XB1 40G); left femur (XB1 40H); left tibia (XB1 40I); a right tibia (XB1 40J0; and sacrum (XB3 40F). The following elements are assigned to this individual using the criteria of age, morphology, and pathology: right humerus (XB1 40A); left radius (XB1 40B); right radius (XB1 40D); right ulna (XB1 40C); right scapula (XB1 40K); left rib fragment (XB1 29); and right rib fragment (XB1 30). This individual is a male 30 to 40 years of age.

The iliac crests, gluteal lines, and ischial tuberosities are all hyperdeveloped. The iliac fossae are abnormally concave, exceedingly thin, and hypervascularized (Plate 33). This condition is attributed to hyperdevelopment of the associated muscles. The acetabular fossae are deep and markedly

TABLE 8

Postcranial metrics for Exhibit B in Centimeters

	Individual 1		Individual 2		Individual 3		Individual 4		Miscellaneous Loc1		Miscellaneous Loc2	
	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Humerus						XB1 40A			XB1 19			XB2 1
Max. Length						32.3			-			29.2
Max. Diam. Midshaft						2.5			1.9			2.0
Min. Diam. Midshaft						1.6			1.3			1.6
Circum. Midshaft						7.1			5.3			6.2
Max. Diam. Head						-			-			4.1
Min. Diam. Head						-			-			3.8
Least Circum. Shaft						6.6			5.0			6.0
Radius					XB1 40B	XB3 40D						
Max. Length					25.2	25.9						
Ulna					XB1 40C							
Max. Length					26.4							
Phys. Length					23.4							
Sacrum												
Max. Ant. Ht.												
Max. Ant. Brdth.												
Innominate	XB1 38A	XB1 38B			XB1 40G	XB1 40E						
Max. Ht.	19.9	20.0			23.2	-						
Max. Brdth.	15.9	-			16.5	-						
Pubis Lth.	7.0	7.1			-	-						
Ischial Lth.	8.5	8.4			9.6	9.7						
I/P Index	82.4	84.5			-	-						
Femur	XB1 38D	XB1 38C	XB1 39D	XB1 39C	XB140H		XB2-2					
Max. Lth.	45.0	45.2	-	-	46.9		-					
Phys. Lth.	44.0	44.6	-	-	46.2		-					
Circum. Midshaft	4.5	4.5	7.6	7.4	10.0		8.3					
Max. Diam. Head	8.3	8.2	-	4.5	5.5		-					
Subtrch. A/P Diam.	2.6	2.6	2.6	2.5	3.2		2.4					
Subtrch. M/L Diam.	3.3	3.2	3.2	3.2	3.9		3.2					
Diam. Midshaft	2.8	2.8	2.4	2.3	3.4		2.6					
Tibia		XB1 41A	XB1 41B	XB1 39E	XB140I	XB740J						
Max. Lth.	-	38.8	37.0	-	38.8	38.8						
Midshaft A/P Diam.	-	3.5	2.4	2.5	3.8	3.9						
Midshaft M/L Diam.	-	2.3	1.9	2.0	2.2	2.4						
Fibula												
Max. Lth.									XB1 37			

TABLE 9

Femoral Torsion for Exhibits
B, F, G, and H.

Side	XB-1 33D Left	XB-1 38 C Right	XB-1 404 Left	XG 45 Left	XF 76 Right	XH 303 Left	XH 307 Right
Indicator of Torsion (Stewart 1962)							
a) Level of Cervical Tubercle	40mm	39mm	56mm	41mm	42mm	46mm	42mm
b) Level of Femoral Head	57mm	75mm	62mm	57mm	76mm	59mm	69mm
c) Difference	17mm	36mm	6mm	16mm	34mm	13mm	27mm
Cervico-Diaphyseal Angle (Steindler 1970)	120^0	128^0	113^0	121^0	126^0	119^0	119^0
Femoral Torsion (Steindler 1970 and VanGerven 1971)	10^0	39^0	13^0	17^0	32^0	17^0	33^0

sclerosed and pitted with extensive marginal lipping. This condition is attributed to degenerative arthritis.

The sacral promontory is irregular, porous, and exhibits projecting osteophytes along the margin (Plate 34). This condition is diagnosed as degenerative arthritis. The lack of neural arch closure of the third, fourth, and fifth scaral vertebrae indicates spina bifida (Plate 35), which is common among the Crow Creek skeletons (Zimmerman et al. 1981).

The gluteal tuberosity, linea aspera, and trochanters of the left femur are all hyperdeveloped. Osseous hypertrophy and osteophytes are exhibited along the femur head margin indicating degenerative arthritis. A similar condition is indicated by marginal lipping of the intercondylar fossa and lateral condyle. A gastrocnemial reaction area is located above the medial condyle.

The tibial tuberosities and popliteal lines of both tibiae are hyperdeveloped. Both tibiae exhibit marginal lipping of the condylar margins and intercondyloid eminences (Plate 36). A small sclerotic area and an adjacent area of eburnation are observable on the medial condyle of the left tibia. These lesions are indicative of degenerative arthritis.

The normal curvature of the glenoid fossa of the scapula is extended by hypertrophic changes. A line of exostosis and pitting is found along the dorsal side of the glenoid fossa. The clavicular facet is enlarged and pitted, again indicating degenerative arthritis.

The greater and lesser tubercular ridges and deltoid tuberosity are well defined. The margin of the humerus head is altered by hypertrophic changes, while there is a small area of porosity just medial to the lesser tuberosity. The trochlea and capitulum are lipped and eroded, while the dorsal olecranon fossa is nearly obliterated by exostosis. These pathological lesions are indicative of degenerative arthritis.

The semilunar notch of the ulna shows marginal lipping. The articular surface of the right radius head is enlarged and porous. The lunate and navicular facets of both radii are heavily lipped, again indicating degenerative arthritis.

The hyperdevelopment of the muscle attachments indicates that this individual engaged in strenous physical activity. The fact that the muscle attachments of the pelvis and legs are comparatively more developed than those of the upper limbs suggests that more stress was placed on the lower limbs. The predominant pathological experience is degenerative arthritis of the following joints listed by decreasing degree of involvement: hips; knees; shoulders; elbows; wrist; and sacro-iliac area. The development of degenerative arthritis is most likely directly related, in this individual, to the hyperdevelopment of the muscles.

Concentration two, Individual four is represented by one left femur (XB2 2). Although the *linea aspera* and size of this adult femur are within the feminine range, an accurate assignment of sex is not possible. No pathologies are observable and femoral torsion can not be determined due to weathering of the proximal end.

Unassignable skeletal elements are treated as individual units because the recovery techniques did not provide sufficient locational data for the further reconstruction of the previously described individuals. Each bone is listed below, along with its identification, any sex and age data, and description of any pathologies present.

Concentration One:

XB1 19: partial left humerus; female traits, older than 15 years.

XB1 20: lumbar vertebra; 17 to 25 years.

XB1 21: tenth thoracic vertebra; older than 17 years. Both the right superior articular facet and left inferior costal pit are enlarged, while the latter displays a lytic lesion.

XB1 22: cervical vertebra; older than 17 years.

XB1 23: cervical vertebra; older than 17 years.

XB1 24: first left rib; very robust; older than 25 years.

XB1 26: right rib.

XB1 27: left rib; older than 25 years.

XB1 28: fragmentary left rib.

XB1 34: right second rib.

XB1 36: left fibula; older than 16 years.

XB1 37: right fibula; older than 18 years and does not pair with XB1 36.

XB1 66: talus.

Concentration Two:

XB2 1: right humerus; 16-25 years.

XB2 3: right rib.

XB2 4: left rib fragment.

XB2 5: rib fragment.

XB2 6: right first rib; older than 25 years.

XB2 7: right rib fragment.

XB2 8: left third metatarsal; older than 17 years.

XB2 9: thoracic vertebra; older than 17 years.

XB2 10: thoracic vertebra; older than 17 years. The inferior surface exhibits a Schmorl's node. The left inferior articular facet is enlarged and porous, while the right superior costal pit is malformed.

XB2 11: lumbar vertebra; older than 17 years.

XB2 12: lumbar vertebra; older than 17 years.

Bone Scatter:

XB3 13: right rib; extremely robust.

XB3 14: left rib fragment; extremely robust; tubercle is enlarged and lipped.

XB3 15: right tibia fragment.

XB3 16: right radius; 15 to 23 years of age.

XB3 17: either tenth or eleventh thoracic vertebra; older than 17 years. The costal pits are enlarged, lipped, and pitted.

XB3 18: cervical vertebra; older than 17 years.

XB3 19: second phalanx of the hand.

Exhibit C 32 EM 1 Havens Site

Exhibit C consists of one tooth recovered from a pothunter's hole on the Havens Site. The Havens Site is an earthlodge village assigned to the Fort Yates phase of the Extended Middle Missouri Variant of the Middle Missouri Tradition (Sperry 1982). The ethnic affiliation of this site is Archaic Mandan (Sperry 1982). The recovered tooth is a heavily worn nonhuman incisor from a large mammal. The best designation that can be made, because of the absence of observable morphological traits, is that it came from either a bison or horse, although elk cannot be ruled out.

Exhibit D 32 ME 42

The archeological and skeletal material labeled Exhibit D was recovered after tree planting activity at site 32 ME 42. In 1947 this site produced a human skeleton found eroding out of a knoll in the Fort Union formation (North Dakota Site Files). Since only one flake was found no cultural affiliation could be assigned. The contents of Exhibit D are listed in Table 10, while the metric data are listed in Table 7. The artifacts include a basalt hammerstone (XD 60; Plate 37), a flake of Knife River Flint, a biface fragment of Knife River Flint, and a plain body sherd. None of these artifacts are culturally diagnostic. All skeletal material was nonhuman and consists of long bone fragments from a large mammal (see Table 10).

TABLE 10

Artifact Descriptions for Exhibit D

53 : Distal metacarpal of a large mammal; spiral fracture.

54 and 55: Miscellaneous split animal bone.

56 : Distal radius of a large mammal.

57, 58, and 59: Miscellaneous split animal bone.

60 : Basalt hammerstone; Plate 37.

61 : Flake of Knife River Flint.

61A: Plain body sherd.

61B: Proximal biface fragment of Knife River Flint.

Exhibit E 32 BO 30

Exhibit E consists of skeletal and artifactual material collected from a blowout on site 32 BO 30 during a Corps of Engineer's "In-House" survey of the Bowman-Haley Reservoir area (Robson 1982). The artifactual material is described in Table 11 and the metric data is listed in Table 7. The artifacts consist of one core of petrified wood and nine flakes or pieces of Knife River Flint. None of the artifactual material is culturally diagnostic and none of the previous work at the site suggests any cultural affiliation (Robson 1982).

A minimum of one human individual is represented by the proximal end of a right femur (XE 62). All other bone fragments in this exhibit are derived from this same badly weathered femur. The individual represented here is 17 years of age or older. No further observations are possible.

Exhibit F Winona Island Vicinity

The skeletal material included in Exhibit F was recovered under unknown conditions on 28 October 1981. As there were no artifacts recovered with Exhibit F and its location on a known site was not indicated, no cultural affiliation can be assigned. The proximity of Exhibit F to Exhibit B suggests the possibility that both exhibits are derived from the same cemetery. If this is the case then there is a good possibility that Exhibit F is historic Arikara, although affiliation with either Yanktonais or Cheyenne cannot be ruled out.

TABLE 11

Artifact Descriptions for Exhibit E

66: Core of petrified wood; patinated.

67 - 72: Six flakes of Knife River Flint.

73: Flake of Knife River Flint; patinated dorsal surface.

74: Unmodified flake of Knife River Flint.

75: Piece of Knife River Flint.

A minimum of one individual is represented by a right femur (XF 76), a right tibia (XF 77), and a left tibia (XF 78). Characteristics of age, sex, and morphology indicate that the cranium (XF 79) belongs to this individual. Characteristics of morphology and size suggests that this individual is a probable female. Dental development and suture closure indicate that this individual is a young adult older than 18 years of age. The predominant pathology is deformation of the cranium due to premature synostosis.

The premature synostosis of the par intermedia and pars asterica of the right lambdoid suture was the most probable cause of the cranial deformity (Plates 38 and 39). The resulting asymmetrical endocranial pressure laterally enlarged the right side of the squamosal, occipital and right mastoid crest. The area inferior to this swelling is markedly thinned and perforated. The right mastoid is shifted anteriorly, while the basilar portion of the cranium is twisted counterclockwise. The condylar articular surfaces are extended dorsally along the rim of the foramen magnum. The left portion of the basilar occipital exhibits a partial cleft. The entire left side of the cranium is tilted superiorly as are the left alveolar and maxillary bones of the face. The right occipital condyle is higher than the left in relationship to the Frankfort Plane, which probably resulted in this individual carrying her head tilted to the right.

All craniometrics are reported in Table 5. Although the cranial deformation renders the results unreliable, the measurements were used to calculate Jantz's discriminant function formula for females (1976). The score of + 0.452 is just below the sectioning point (+ 0.490) into the Arikara range. Because the face and overall cranial height were only slightly affected by the deformation, the auricular height index is probably more reliable. Using the auricular height index of this cranium (74.6) and the distribution of this index within the Plains as published by Jantz (1977), this cranium has a good chance of being one of the following depending upon the time of burial: Arikara (historic); South Dakota Coalescent (1550-1800 A.D.); or Central Plains Tradition (< 1550 A.D.). These results must be considered tenuous at best due to the cranial deformation. It should be mentioned, that if this burial's proximity to Exhibit B indicates that it belongs to the same cemetery, then Exhibit E's craniometrics strengthens the cultural designation of Exhibit B as historic Arikara.

When compared to the dentitions from the other exhibits, the teeth from Exhibit F are unusual. The teeth are only slightly worn (Table 12 and Plate 40) and the left second molar has one occlusal carie. Two episodes of childhood stress at 2.5-3.0 years and 3.5-4.0 years are indicated by two hypoplastic episodes.

The low magnification (19x) scanning electron micrograph of the left first maxillary molar shows the extensive pitting of the enamel surface (Plate 41). A high magnification (1500x) micrograph shows details of the pitted surface and the low frequency of striations (Plate 42). This pattern is typical of southeastern burials found in association with nut hulls. At the present time this pattern must be interpreted to mean that this individual was eating nuts or unprocessed hard seeds just prior to death (two to six weeks).

The right femur (XF 76) displays a torsion angle of 32^{0} (Tables 9 and 13) which is similar to the angle of the right femur from Exhibit B. Without a left femur it is not possible to determine if the same torsion asymmetry exists in Exhibit F. Neither the femur nor tibiae exhibit any pathologies.

TABLE 12

Dental Data for Exhibit F

Maxillary	P/D	Pres.	Erup.	Alved.	Calcu.	Carie	Abscess	Wear Murphy	Wear Scott
^3M	X	3A	1	X	X	X	1	X	X
^2M	P	1A	1	2	1	1/2	1	0	8
^1M	P	1A	1	2	1	1	1	0	12
^4P	X	3A	1	X	X	X	1		
^3P	X	3A	1	X	X	X	1		
^xC	X	3A	1	X	X	X	1		
^2I	X	3A	1	X	X	X	1		
^1I	X	3A	1	X	X	X	1		
I^1	X	3A	1	X	X	X	1		
I^2	P	1A	1	2	1	1	1		
C^x	X	3A	1	X	X	X	1		
P^3	X	3A	1	4	X	X	2		
P^4	X	3A	1	X	X	X	1		
M^1	P	1A	1	2	2	1	1	0	11
M^2	X	3A	1	X	X	X	1	X	X
M^3	X	3A	1	X	X	X	1	X	X

Code:
(1) X = Unobservable
(2) P = Permanent, D = Deciduous
(3) 1A = Present in socket, completely formed
3A = Absent Postmortem, completely formed
(4) Eruption
1 = Completely erupted
(5) Alveolar Resorption
2 = Slight 1-3 mm.
(6) Calculus Deposit
1 = None
2 = Slight: discrete areas
(7) Caries Presence and Location
1 = None
1/2 = one carie in pit and fissure location
(8) Abscess Presence and Size
1 = None

TABLE 13

Postcranial Metrics for Exhibit F in Centimeters

	Left	Right
Femur		XF 76
Maximum Length		41.9
Physiological Length		41.1
Circum. Midshaft		7.7
Maximum Diameter Head		4.2
Subtrch. M/P Diameter		2.5
Subtrch. M/L Diameter		3.3
Diameter Midshaft		2.5
Tibia	XF 78	XF 77
Maximum Length	34.8	34.8
Midshaft A/P Diameter	3.0	2.9
Midshaft M/L Diameter	1.9	1.9

Exhibit G 32 EM 102

The Exhibit G material was recovered from site 32 ME 102 on 10 October 1980 under unknown circumstances. The site file recorded in 1969 indicates that the site was then eroding from the banks of Lake Oahe and thus suggests that Exhibit G was recovered under similar circumstances. When 32 EM 102 was located during the Smithsonian Institution River Basin Survey, the materials collected indicated that this site is a probable prehistoric Mandan earthlodge site. The artifactual material collected in 1980 consists of a distal radius from a medium size mammal (XG 43) and two pieces of brown bottle glass (XG 50 and 51). None of this material is culturally diagnostic. See Table 14 for description and Table 7 for metric data. At the present time the skeletal material from Exhibit G is considered to be prehistoric Mandan or Hidatsa, as the two cannot be archeologically distinguished.

A minimum of one individual is represented by a left femur (XG 45) which articulates well with a partial left innominate (XG 46). The other skeletal elements listed under miscellaneous probably belong to this individual, although the association cannot be positively established. Preservation is poor making sex and age determination difficult. Sex markers are indeterminate, while an age in excess of 30 years is indicated.

The metric data for the left femur (XG 45) are listed in Tables 9 and 15. The femoral torsion angle is 17^{o}, which is low and comparable to the low angles observed on the left femora from Exhibit B (Table 9). Although a right femur is not available for examination, the consistency of low left femoral torsion angles suggests a consistent pattern of asymmetry. The femoral condyles exhibit symmetrical osteophytes, while the intercondylar fossa is lipped indicating degenerative arthritis (Plate 43).

TABLE 14

Artifact Descriptions for Exhibit G

43: Left distal radius of medium size mammal.

49: Left rib of medium sized mammal.

50 and 51: Two pieces of brown bottle glass.

52: Unidentifiable fragment of bone.

TABLE 15

Postcranial Metrics for Exhibit G

	Left XG 45
Femur	
Maximum Length	43.4
Physiological Length	43.0
Circum. Midshaft	8.5
Maximum Diameter Head	4.2
Subtroch. A/P Diameter	2.4
Subtroch. M.L Diameter	3.3
Diameter Midshaft	2.6

Miscellaneous human bone includes:

XG 44: left ulna; older than 15 years

XG 47: fragmentary right parietal.

XG 48: left fifth metacarpal; older than 16 years.

Exhibit H 32 SI 3 Robert Zahn Site

The material contained in Exhibit H was recovered from the Robert Zahn Site on 5 November 1981 by Corps of Engineers personnel (Robson 1981). The skeletal material was found exposed by beach erosion and subsequently removed under adverse archeological conditions (Plate 44). The articulated skeleton was flexed and laid on its right side with the head toward the south (Robson 1981). Although this burial was in the vicinity of the Robert Zahn Site, there is no certainty that the burial is associated with this archaic Mandan earth lodge village (site file). The artifacts recovered with this burial do not appear to be grave goods, but rather associated with the village (Robson 1981). Because of adverse soil conditions and extensive erosion, it was not possible to determine if there were any grave goods with this burial.

The artifactual material from Exhibit H consists of 13 sherds, scorea, one biface fragment, and a scapula squash knife. The metric characteristics are listed in Table 7 and the artifacts are described in Table 16. The eight rim sherds are provisionally assigned to the Extended Middle Missouri wares, Riggs and Fort Yates, based on published descriptions and photographs (Calabrese 1972; Lehmer 1971; Sperry 1982). Two rims (XH 320, Plate 52; XH 321) are Fort Yates Cord Impressed; four are Riggs Decorated Lip (XH 317, Plate 49; XH 319, Plate 51; XH 322, Plate 54; XH 323, Plate 55); and one is Riggs Plain Lip (XH 311). A final exterior sherd fragment (XH 312, Plate 48) is not assigned to a

TABLE 16

Artifact Descriptions for Exhibit H

308: Distal biface fragments of Tongue River Silicified Sediment; transverse break; Plate 45.

309: Scorea or clinker; possibly ground; Plate 46.

310: Animal bone scapula squash knife; Plate 47.

311: Plain rim sherd.

312: Trailed body sherd; carbonized interior; Plate 48.

313: Simple stamped body sherd.

314 and 315: Plain body sherd.

316: Ceramic fragment.

317: Plain rim sherd; serated lip; carbonized interior and exterior; Plate 49.

318: Plain rim sherd; Plate 50.

319: Smoothed overtrailed rim sherd; raised lip on interior; Plate 51.

320: Rim sherd, horizontal cord wrapped stick impressed; carbonized interior, Plate 52.

321: Rim sherd, horizontal cord impressed; Plate 53.

322: Rim sherd, vertical linear incised lip, carbonized interior and exterior; Plate 54.

323: Rim sherd, vertical fingernail impressed lip, carbonized interior and exterior; Plate 55.

type, but is incised or has a trailed surface treatment. Extended Middle Missouri sites from the Cannonball River area, such as Havens (Exhibit C) and Robert Zahn are radiocarbon dated between about A.D. 1000 and 1500 (Theissen 1977) and are ethnically assigned to the Mandan/Hidatsa.

A minimum of two individuals are represented in this exhibit. Individual 1 is almost a complete skeleton with all major skeletal elements represented. All indicators suggest that this is a female in excess of 50 years of age. The dominant pathologies include senile osteoporosis, degenerative arthritis of the major joints, osteophytosis of the spine, and extensive inflammatory lesions of the elbow and knee joints. Unfortunately the inflammatory lesions do not present a clear diagnostic pattern and thus could be one of any number of diseases including tuberculosis and adult rheumatoid arthritis. Cranoimetrics suggest a Mandan/Hidatsa ethnic affiliation. Individual 2 is represented by a partial mandible and teeth. Sex could not be determined, while dental attrition and development indicate adult status. This mandible does not articulate with the cranium from Individual 1 and was recovered three feet to the west of Individual 1 (Robson 1981). This mandible indicates the presence of additional burials in this vicinity.

Individual 1 consists of an entire skeleton (see Table 17 for detailed inventory) lacking only the small bones such as those from the hand. Both size and morphology indicators from the cranial and postcranial skeleton indicate that this individual is a female. Metric data for the cranium is listed in Table 5 and the postcranial data is listed in Table 18. Both the pubic symphysis and sacral surface of the ilium indicate an age in excess of 50 years. It should be mentioned that the presence of senile osteoporosis and generalized degenerative arthritis could have influenced the age determination.

The vertebrae, sacrum, innominates, tibiae, sternum, ribs, humeri, ulnae, radii, and femora are all remarkably light in weight. The radiographs of these elements all show a comparative decrease in density. The radiographs indicate that the thoracic 9-12 vertebrae are the focus of spinal bone loss. The femoral head radiographs show an expanded Ward's triangle and reduction in trabecular architecture. All these features are characteristic of senile osteoporosis which is usually most dramatic in females past the fifth decade (Ortner and Putschar 1981) and not uncommon among prehistoric Dakota populations (Zimmerman et al. 1981).

Both humeri exhibit extensive inflammatory lesions on their distal articular surfaces (Plate 56). The lesion on the right humerus (XH 294) is more extensive than on the left (XH 293). This may account for the more advanced osteoporotic bone loss of the right humerus. The fifth lumbar vertebra (XH 299) has the neural arch separated from the body (Plate 57). The detached portions exhibit extensive lytic lesions which perforate the bone. The clavicular notches of the sternum (XH 246) are enlarged, pitted, and exhibit lytic lesions. The lesser tubercle of the right humerus is porous and has lytic lesions. Similar resorptive lesions are observed on the lateral condyle of the right femur (XH 307, Plate 58), where the surface is highly irregular with deep smooth walled cavities joining progressively to produce large irregular depressions. This wide spread inflammatory lesion of the major joints is not diagnostically typical of any one disease. In some respects these lesions resemble joint tuberculosis, but without extensive involvement of other skeletal elements the diagnosis is tentative. The lesions also resemble rheumatoid arthritis, however without phalanges to examine, diagnosis is uncertain. It should also be mentioned that the fungal diseases, such as blastomycosis, cannot be ruled out.

TABLE 17

Skeletal Inventory for Exhibit H

	Frontal	Parietal	Occipital	Temporal	Zygomatic	Sphenoid	Maxilla	Ethmoid	Lacrimal	Vomer	Palate	Mandible	Cervical	Thoracic	Lumbar	Sacrum
	L R	L R	L R	L R	L R	L R	L R	L R	L R		L R	L R				
Individual 1	C C	C C	C C	C C	C C	C C	C C	C C	C C	F	C C	A A	C	C	C	C
Individual 2	A A	A A	A A	A A	A A	A A	A A	A A	A A	A	A A	F C	A	A	A	A

	Ribs	Sternum	Clavicle	Scapula	Humerus	Ulna	Radius	Carpals	Metacarpals	Phalange (Hand)	Ilium	Pubis	Ischium	Patella	Femur	Tibia
	L R		L R	L R	L R	L R	L R	L R	L R	L R	L R	L R	L R	L R	L R	L R
Individual 1	C C	C	A C	A C	C C	C C	C C	A A	A A	A A	C C	C C	A C	A A	C C	C C
Individual 2	A A	A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A	A A

	Fibula	Tarsals	Metatarsals	Phalange (Foot)
	L R	L R	L R	L R
Individual 1	A C	F F	A A	A A
Individual 2	A A	A A	A A	A A

Key: C = 90%+ complete
P = 40 - 90%
F = Less than 40%
A = Absent

TABLE 18

Postcranial Metrics for Exhibit H in Centimeters

	Individual 1 Left	Right
Scapula		XH 245
Max. Length		-
Max. Breadth		9.5
Clavicle	XH 248	
Max. Length	13.3	
Circum. Midshaft	3.2	
Humerus	XH 293	XH 294
Max. Length	30.3	30.8
Max. Diam. Midshaft	2.2	2.3
Min. Diam. Midshaft	1.3	1.3
Circum. Midshaft	6.0	6.2
Max. Diam. Head	4.2	4.2
Min. Diam. Head	4.0	4.1
Least Circum. Shaft	5.6	5.9
Radius	XH 289	XH 292
Max. Length	22.6	22.7
Ulna	XH 290	XH 291
Max. Length	24.8	25.0
Phys. Length	21.6	21.8
Sacrum	XH 300	
Max. Ant. Height	-	
Max. Ant. Breadth	12.0	
Innominate	XH 301	XH 302
Maximum Height	20.3	20.2
Maximum Breadth	-	15.7
Pubis Length	8.1	7.1
Ischial Length	-	8.2
I/P Index	-	86.5
Femur	XH 303	XH 307
Maximum Length	42.7	41.9
Phys. Length	42.3	41.5
Circum. Midshaft	8.3	7.9
Max. Diam. Head	4.4	4.3
Subtroch. A/P Diam.	2.4	2.2
Subtroch. M/L Diam.	3.4	3.3
Diam. at Midshaft	2.6	2.4

TABLE 18
(Cont)

Postcranial Metrics for Exhibit H

	Individual 1 Left	Right
Tibia	XH 304	XH 306
Maximum Length	35.6	35.2
Midshaft A/P Diam.	3.2	3.1
Midshaft M/L Diam.	2.0	2.0
Fibula		XH 305
Max. Length		34.1

TABLE 19

Dental Data for Exhibit H

Maxillary	Individual 1 (XH 243)							
	P/D	Pres.	Erup.	Alveo.	Calcu.	Carie	Abscess	Wear
^3M	X	2A	1	4	X	X	1	X
^2M	X	2A	1	4	X	X	1	X
^1M	X	2A	1	4	X	X	1	X
^4P	X	2A	1	4	X	X	1	X
^3P	X	2A	1	4	X	X	1	X
^xC	X	2A	1	4	X	X	1	X
^2I	X	2A	1	4	X	X	1	X
^1I	X	2A	1	4	X	X	1	X
I^1	X	2A	1	4	X	X	1	X
I^2	X	2A	1	4	X	X	1	X
C^x	X	2A	1	4	X	X	4	X
P^3	X	2A	1	4	X	X	1	X
P^4	X	2A	1	4	X	X	1	X
M^1	X	2A	1	4	X	X	1	X
M^2	X	2A	1	4	X	X	1	X
M^3	X	2A	1	4	X	X	1	X

Mandibular	Individual 2 (XH 241)							
	P/D	Pres.	Erup.	Alveo.	Calcu.	Carie	Abscess	Wear
$_3M$	X	2A	1	4	X	X	1	X
$_2M$	X	3A	1	X	X	X	1	X
$_1M$	X	2A	1	4	X	X	1	X
$_4P$	P	1A	1	4	3	1	1	
$_3P$	X	2A	1	4	X	X	1	
$_xC$	P	1A	1	4	3	1	1	
$_2I$	P	1A	1	4	3	1	1	
$_1I$	X	3A	1	X	X	X	1	
I_1	P	1A	1	4	4	1	1	
I_2	P	1A	1	3	4	1	1	
C_x	P	1A	1	4	4	1	1	
P_3	P	1A	1	4	3	1	1	
P_4	X	X	X	X	X	X	X	X
M_1	X	X	X	X	X	X	X	X
M_2	X	X	X	X	X	X	X	X
M_3	X	X	X	X	X	X	X	X

CODE:
1) X = Unobservable
2) P = Permanent
3) D = Deciduous
4) 1A = Present in socket, completely formed
   2A = Absent antemortum, with evidence of socket resorption.
   3A = Absent postmortum, completely formed.
5) Eruption
   1 = Completely erupted
6) Alveolar Resorption
   3 = Moderate 3 - 5 mm.
   4 = Severe more than 5mm.
7) Calculus Deposit
   3 = Moderate: Coalesced areas.
   4 = Heavy: Three-dimensional deposits.
8) Carie
   1 = None
9) Abscess
   1 = None
   4 = Larger than 5mm diameter

All the *maxillary dentition* has been lost *antemortem* with all but two sockets completely resorbed (see Table 19). Both mandibular fossae are deepened and marginally lipped, while the left displays a small erosive lesion. These features are characteristic of tempero-mandibular joint disease, possibly related to tooth loss.

The medial surfaces of both external auditory meatus are thinned, while the right is perforated. The right foramen lacerum and right jugular fossa are partially occluded by osseous proliferation.

Degenerative arthritis is widespread throughout the joint surfaces of this individual. The occipital condyles are dorsally lipped, while the medial surfaces show hypertrophic changes and erosion. All of the articular portions of the tubercles and heads of the ribs are enlarged and pitted. The conoid and deltoid tubercles of the clavicle (XH 248, Plate 59) are enlarged and flare laterally. The acromial end exhibits proliferation and pitting with one lytic lesion. The right scapula (XH 245) shows corresponding changes with an enlarged and lipped clavicular facet. The glenoid fossa is slightly lipped on the superior rim, which corresponds to hypertrophic changes of the heads of the humeri (XH 293 and XH 294). The semilunar notches of both ulnae (XH 290 and XH 291) exhibit marginal lipping, which may reflect a response to the lesions of the humeri. Marginal lipping of the radial notches corresponds to lipping of the radial heads (XH 292 and XH 289). The lunate, navicular, and ulnar notches also show pronounced lipping. In summary, the sternoclavicular and acromioclavicular joints of the shoulder girdle, the shoulder joints, elbow joints, and joints of the wrist all show evidence of degenerative arthritis.

The acetabulae of the innominates (XH 301 and XH 302) exhibit erosive and porous lesions on the superior and anterior peripheries of the lunate surfaces. The superior border of the outer rims are marginally lipped as are the femoral heads (XH 303 and XH 307). The condyles of the femora are marginally lipped with porosity along the medial rim of the medial condyles. The articular surfaces of the tibial condyles (XH 305 and XH 306) are porous with greatest destruction on the lateral condyles. The distal articular surfaces are lipped as are the corresponding surfaces of the calcanea (XH 237 and XH 238). In summary the hip, knee, and ankle joints all exhibit degenerative arthritis.

The entire vertebral column is involved with degenerative changes exhibited as both osteophytosis and osteoarthritis. The inferior surface of the axis body (XH 271) is porous, as are both surfaces of cervical vertebrae three through seven (XH 272 - 276). This osteoporotic condition is also observed in the radiographs and becomes progressively more pronounced along the vertebral column. The left inferior articular facet of C3 and C4 are enlarged and lipped, while all articular facets of C5, C6, and C7 are enlarged and lipped. The thoracic vertebrae (XH 277 - 288) exhibit similar lesions which again become more pronounced inferiorly. The body surfaces are porous and exhibit coral-like surfaces that in conjunction with the radiographic data indicates osteoporosis. Initial osteophytotic lipping of the body begins on the fifth thoracic and becomes progressively more pronounced. The articular facets of all vertebrae exhibit porosity and irregularities. All costal pits are enlarged and display lytic lesions which are most dramatic on the middle thoracic (T5 - 8) vertebrae. All articular portions of the tubercles and heads of the ribs (left XH 254, 255, 262, 263, 264, 265, and 266; right XH 249, 250, 251, 252, 253, 256, 257, 258, 259, 260, and 268) are enlarged and porous demonstrating an associated lesion with the vertebrae. All lumbar vertebrae (XH 295 - 299) exhibit classic osteophytotic lipping of the bodies. The body surfaces are irregular and pitted. The articular facets become more irregular and lipped as the fifth lumbar is approached. In summary, the vertebral bodies and articular surfaces all show the classic lesions of osteoporosis and degenerative arthritis.

Similar to Exhibit B, both femora display abnormal torsion of the head area to the shaft (Table 9, Plate 60). The left femur (XH 303) has extreme retroversion (17^0), while the right has extreme anteversion (33^0). The asymmetry is not quite as severe as that found in Exhibit B.

All twelve of Jantz' (1976) discriminant functions measurements were obtained for this crania (Plates 61 and 62). The female discriminant formula produced a score of + 0.629, which is above the sectioning point (+ 0.490) and well into the Mandan range. Using Jantz' (1976) methodology this skull has a probability of 0.32 of being Mandan and a 0.001 probability of being Arikara. Using the auricular height index of this cranium (71.2) and the distribution of this index within the Plains (Jantz 1977), this individual has a good chance of being one of the following depending upon the time of interment: Mandan (historic); North Dakota Coalescent (1600-1800 A.D.); Middle Missouri Tradition (1000-1500 A.D.); or Northern Plains Archaic and Woodland (< 1000 A.D.). Keeping in mind the limitations of these methodologies and the fact that we must assume knowledge of all possible ethnic groups, this individual is most probably Mandan/Hidatsa. The craniometric determination of ethnic affiliation corresponds nicely with the artifactual assignment to the Middle Missouri Tradition.

Individual 2 is represented by a partial mandible (XH 241) and the following teeth: two premolars, two canines, and two incisors (Plate 63). Sex is not determinable and the dental development and attrition indicate an adult age. Dental attrition is extensive as are calculus deposits (Table 19). Alveolar resorption is extreme indicating periodontal disease and antemortem tooth loss. The mandibular condyle displays an irregular articular surface suggestive of tempromandibular joint disease.

The material contained in Exhibit I was recovered by a local Fort Yates physician from the shoreline along the townsite of Fort Yates on 1 October 1980 under unknown circumstances. The juvenile cranium has been reconstructed and thus possibly was obtained from a collector. The material is not assigned to a known site and contains no artifactual material. Thus Exhibit I cannot be assigned to any cultural or temporal association.

Exhibit I contains a minimum of four individuals including three adults and one juvenile. The four individuals are represented by two left adult femora, one pair of adult femora and one juvenile femur. The size and morphology of all the skeletal elements suggest the presence of one male between 25 and 35 years of age, one female, and one adult of unknown sex. The most remarkable feature of this collection is the presence of the femoral anteversion-retroversion observed in the other exhibits. Also notable is the absence of degenerative arthritis. Many of the miscellaneous long bones show splintering which suggests breakage while green, and several are possible tools. This evidence of mutilation is consistent with reports from South Dakota archeological sites, where mutilation of human bodies occurred during warfare (Owsley et al. 1977; Zimmerman et al. 1981). Individual 1 consists of right (XI 186) and left femora (XI 196) from an adult. The size and morphology indicate male characteristics. No pathologies are observable. Although femoral torsion could not be measured because of missing condyles, visual assessment suggests retroversion of the left and anteversion of the right. The postcranial metrics for Exhibit I are listed in Table 20. Individual 2 consists of a left femur (XI 195) which is from an adult in excess of 17 years of age. The size and morphology are not suggestive of either sex. This femur

TABLE 20

Postcranial Metrics for Exhibit I in Centimeters

	Left	Right	Left	Left
Humerus	XI 192			
Max. Length	-			
Max. Diam. Midshaft	2.3			
Min. Diam. Midshaft	1.7			
Circum. Midshaft	7.3			
Max. Diam. Head	4.4			
Min. Diam. Head	4.0			
Least Circum. Shaft	6.5			
Innominate	XI 192			
Max. Ht.	-			
Max. Brdth.	16.1			
Pubis Lth.	8.0			
Ischial Lth.	-			
I/P Index	-			
Femur	XI 196	XI 186	XI 195	XI 197
Max. Lth.	-	-	-	-
Phys. Lth.	-	-	-	-
Circum. Midshaft	9.5	9.5	8.5	7.7
Max. Diam. Head	-	-	-	-
Subtroch. A/P Diam.	2.9	2.8	2.4	2.2
Subtroch. M/L. Diam.	3.8	3.7	3.3	3.1
Diam. Midshaft	3.1	3.2	2.8	2.4

displays retroversion similar to the other exhibits. A gastrocnemial reaction superior to the medial condyle is the only anomally. Individual 3 is represented by a left femur (XI 197) from an adult in excess of 17 years of age. The size and morphology suggest a female designation. No pathologies are observable except retroversion. The fragmentary nature of all the femora in Exhibit I prevents the measurement of femoral torsion. Individual 4 is represented by a right femoral shaft from a juvenile. No pathologies are present. It is most likely that the juvenile cranium (XI 234) belongs with this femur (Plates 64 and 65). Dental development indicates an age of five years +/- 16 months (Plate 66). Both superior eye orbits exhibit mild cribra orbitalia suggestive of iron deficiency anemia. The dental data are listed in Table 21.

Because none of the miscellaneous bones can be assigned to the above mentioned individuals, they will be described separately.

XI 187: right humerus shaft; both proximal and distal ends exhibit splintering; Plate 67.

XI 188: right tibia; older than 18 years; distal end splintered and edges indicate use as tool; Plate 68.

XI 189: left tibia; older than 18 years; distal end splintered.

XI 191: left radius; older than 18 years.

XI 193: left distal humerus shaft.

XI 194: left fibula; older than 18 years.

XI 198: left innominate; aged 25-35 years; male. This element indicates the age of Individual 1 as it probably belongs with this individual, but there is no direct evidence for this.

XI 199: right illium; older than 18 years.

XI 200: proximal tibia; splintered with evidence of use as tool; Plate 69.

TABLE 21

Dental Data for Exhibit I
Cranium (XI 234)

Maxillary	P/D	Pres.	Erup.	Alveo.	Calcu.	Abscess	Wear Murphy	Wear Scott
^{2}M	P	1C	3	X	X	1		
^{1}M	X	3A	2	X	X	1		
^{2}Md	d	1A	1	2	1	1	0	6
^{1}Md	d	1A	1	2	1	1	0	7
^{x}Cd	X	3A	1	X	X	1		
$^{2}I/^{2}Id$	P/X	1B/3A	3/1	X	X	1		
^{1}Id	X	3A	1	X	X	1		
Id^{1}	X	3A	1	X	X	1		
I^{2}/Id^{2}	P/X	1B/3A	3/1	X	X	1		
Cd^{x}	X	3A	1	X	X	1		
Md^{1}	d	1A	1	2	1	1	0	7
Md^{2}	d	1A	1	2	1	1	0	6
M^{1}	X	3A	2	X	X	1		
M^{2}	P	1C	3	X	X	1		

Code: 1) X = Unobservable
2) P = Permanent
d = Deciduous
3) Present
1A = Present in socket, completely formed
1B = Present in socket, root incomplete
1C = Present in socket, crown only formed.
3A = Absent postmortem, completely formed
4) Eruption
1 = Complete
2 = Partially
3 = Unerupted
5) Alveolar Resorption
2 = Slight, 1-3mm
6) Calculus
1 = None
7) Abscess
1 = None

XI 201: right radius; older than 15 years; distal end splintered with evidence of use as tool.

XI 203: left ulna; older than 15 years, distal end splintered; Plate 70.

XI 204: first phalanx of hand.

XI 205: left rib; adult.

XI 207: right rib shaft.

XI 208: right rib.

XI 209, 210, 213, 214, 219, 220, 221, 222, and 217: nine left rib fragments.

XI 211: right rib; aged 14-25 years.

XI 212: right rib fragment; older than 14 years.

XI 213: metacarpal fragment.

XI 223: bifurcated spine of a cervical vertebra.

XI 225: fragmentary left scapula; older than 20 years.

XI 230: cervical vertebra; older than 17 years.

XI 232: right lateral epicondyle of humerus.

XI 233: distal end right radius; older than 18 years.

In summary these miscellaneous skeletal elements are all consistent with the four postulated individuals. The only remarkable features of these long bones are the splinter fractures and possible use as tools of the human long bones. Splintering suggests purposeful breakage of the bone shortly after death. The most frequently splintered bones are the terminal long bones of the arms and legs which suggests forceful removal of hands and feet, a common practice in Plains warfare (Owsley et al. 1977).

TABLE 22

Degree of Expression of Cranial and Post-Cranial Nonmetric Traits for Exhibits A, F, and H (After Buikstra)

Trait	Exhibit A XA 160-4			Exhibit F Individual 1 (XF 79)			Exhibit H Individual 1 (XH 243)			Exhibit H Individual 2 (XH 241)		
Cranial:	Right	Left	Medial	Right	Left	Medial	Right	Left	Medial	Right	Left	Medial
Epipteric Bone	9	9		1	1		1	1		9	9	
Asterionic Bone	1	1		1	1		1	1		9	9	
Parietal Notch Bone	1	1		1	1		1	1		9	9	
Os Lambdoid Suture	1	1		9	1		1	1		9	9	
Os Coronal Suture	1	1		1	1		1	1		9	9	
Os Japonium	1	1		1	1		1	1		9	9	
Intra-Orbital Suture	1	1		1	1		1	1		9	9	
Parietal Notch	9	9		1	1		2	2		9	9	
Supra-Orbital Notch	2	1		1	1		2	2		9	9	
Supra-Orbital Foramina	1	2		2	2		1	2		9	9	
Accessory Supra-Orbital Foramina	2	1		1	1		2	1		9	9	
Multiple Mental Foramina	1	9		9	9		9	9		1	9	
Mylo-Hyoid Arch	2	9		9	9		9	9		1	9	
Accessory Infra-Orbital Foramina	1	1		1	1		2	1		9	9	
Tympanic Dihiscence	1	1		1	1		1	1		9	9	
Auditory Exostoses	1	1		1	1		1	1		9	9	
Divided Hypoglossal Canal	1	1		1	1		2	1		9	9	
Post-Condylar Canal Not Patent	2	2		2	1		1	1		9	9	
Foramen Spinosum open to F. Lacerum	1	1		1	1		1	1		9	9	
Multiple Zygomatico-Facial Foramina	3	3		1	1		1	1		9	9	
Pterygo-Alar Spurs	2	9		2	1		2	1		9	9	
Pterygo-Spinous Spurs	2	2		2	2		1	1		9	9	
Metopic Suture Open			1			1			1			9
Bregmatic Bone			1			1			1			9
Inca Bone			1			1			1			9
Apical Bone			1			1			1			9
Os Sagittal Suture			1			1			1			
Mandibular Torus	1	9		9	9		9	9		1	9	
Palatine Torus			1			1			1			9
Obelionic Foramina	1	2					1	1		9	9	
Foramen Ovale Incomplete	1	1		1	1		1	1		9	9	

TABLE 22
(Cont.)

Degree of Expression of Cranial and Post-Cranial Nonmetric Traits for Exhibits A, F, and H (After Buikstra)

Trait	Exhibit A XA 160-4			Exhibit F Individual 1 (XF 79)			Exhibit H Individual 1 (XH 243)			Exhibit H Individual 2 (XH 241)		
	Right	Left	Medial	Right	Left	Medial	Right	Left	Medial	Right	Left	Medial
Post Cranial:												
Atlas: Lateral Bridging	9	9		9	9		1	1		9	9	
Atlas: Posterior Bridging	9	9		9	9		1	1		9	9	
C3: Accessory Foramina	9	9		9	9		1	1		9	9	
C4: Accessory Foramina	9	9		9	9		1	1		9	9	
C5: Accessory Foramina	9	9		9	9		1	2		9	9	
C6: Accessory Foramina	9	9		9	9		2	1		9	9	
C7: Accessory Foramina	9	9		9	9		9	1		9	9	
L5: Spondylysis	9	9		9	9		9	9		9	9	

Code: 1 = Not Present
2 = Present
3 = Three Foramina Present

SUMMARY AND CONCLUSIONS

In his review of Great Plains Physical Anthropology Hughey (1980) enumerates three research goals: 1) reconstruction of gene flow and migration; 2) use of paleodemography, paleoepidemiology, and non-specific stress indicators to measure and interpret changes in Plains adaptive efficiency; and 3) use of dietary reconstruction and estimation of nutritional adequacy to document changes in the bioenergetics of Plains cultures. The research goal of the Multicounty Bioarcheology Project is to apply the data gathered from the previously described nine collections of prehistoric and historic American Indian skeletal and artifactual material to the further achievement of Hughey's research goals. The nine collections produced a minimum of sixteen individuals from seven exhibits, while two (Exhibits C and D) produced only nonhuman skeletal material. These sixteen individuals are discussed as a group within the context of Plains bioarcheology using the following topical categories: archeological context; ethnic affiliation; demography; paleopathology; stress indicators; dietary reconstruction; and postcranial metric variation. The report is concluded with a series of recommendations for mitigating the impact of lakeshore erosion upon the archeological resources of North Dakota.

Determination of the archeological context of the nine exhibits was severely hampered by the emergency nature of the field recovery circumstances and the absence of documentation for several of the exhibits. A small scale literature and site data search was conducted to determine the cultural and temporal association of the exhibits. Published reports, manuscripts, "In-House" reports, and site forms are all used to provide temporal and cultural associations for the skeletal material. The archeological context and ethnic affiliation of the exhibits are discussed jointly and organized by reservoir.

Exhibits A and D are both located on the shores of Lake Sakakawea and although both exhibits are from reported sites (Exhibit A, 32 ME 463; Exhibit B, 32 ME 42), neither site form provides any information concerning temporal or cultural association. Exhibit D produced only mammalian long bone fragments and will be accorded no further discussion. Exhibit A produced a minimum of three adult individuals (Table 23) which includes one complete male cranium. Using Jantz' (1976) discriminant function formula for males the cranium is classified as Arikara. Using the auricular height index (Jantz 1977) the cranium is classified as Mandan. Prior to 1500 A.D. the auricular height index clearly distinguishes Mandan and Arikara, while after this date the two groups are indistinguishable. Without temporal or cultural control it is not possible to correctly assign this individual to an ethnic group with these ambiguous results. The best possible judgment is to consider Exhibit A as representative of a late prehistoric group with a mixed Mandan-Arikara genetic background or representative of some craniometrically unknown group such as the Sioux.

Exhibit E (32 BO 30) is located on the shore of Bowman-Haley Lake and consists of one badly weathered human femur. Since neither the site form nor "In-House" survey report (Robson 1982) provide any cultural or temporal association for this single bone, Exhibit E will not be discussed further.

Exhibits B, C, F, G, H, and I are all located along the shores of Lake Oahe just north of the South Dakota state line. Analysis of the artifacts associated with Exhibit B indicates that they are derived from a historic Arikara village (circa 1815 - 1839), although affiliation with other groups such as the Yanktonais or Cheyenne cannot be ruled out. Unfortunately it is

TABLE 23

Demographic Characteristics of the Nine Multicounty Exhibits

Exhibit	Archeological Context	Ethnic Affiliation					
		Non Human	Unknown	Arikara - Mandan Mixed	Arikara	Mandan	Total
A	Unknown			Male 25+ yrs. Male 20+ yrs. Female 25+ yrs.			3
B	Historic Arikara				Female 22-29 yrs. ? 17-19 yrs. Male 30-40yrs. ? Adult		4
C	Extended Middle Missouri Tradition	Incisor					
D	Unknown	Long Bones					
E	Unknown		? 17+ yrs.				1
F	Unknown				Female Young Adult		1
G	Mandan Earth Lodge					? 30+ yrs.	1
H	Extended Middle Missouri Tradition					Female 50+ yrs. ? Adult	2
I	Unknown		Male Adult ? Adult Female Adult ? 5 yrs.				4
Total			5	3	5	3	16

not possible to determine stratigraphically if the artifacts are grave goods or slope wash from a nearby village. Only the similarities to the Leavenworth grave goods suggests the association of artifacts and skeletal remains. These data are used to tentatively assign the minimum of four adult skeletons to the historic Arikara. The close proximity of Exhibits B and F suggests the possibility that they both could have come from the same cemetery. Unfortunately there are no cultural data associated with Exhibit F which could be used to establish this connection. Both the discriminant function formula and auricular height index indicate that the one female cranium from Exhibit F is Arikara. It should be recalled that this cranium is deformed and thus the ethnic affiliation should be considered suspect. However, since the ethnic assignment of Exhibit F supports the cultural assignment of Exhibit B, both exhibits may be considered Arikara.

Using either site forms or excavation reports Exhibits C (32 ME 1) and H (32 SI 3) are assigned to the Extended Middle Missouri Tradition, while Exhibit G (32 EM 102) is referred to as a Mandan Earth Lodge site. As stratigraphic control is absent these assignments must be considered tentative. This conclusion is supported by craniometric analysis of the female from Exhibit H which classifies as Mandan by both the discriminant function formula and auricular height index. Exhibit H ceramics conform as well to the proposed Mandan skeletal affiliation, but is at best only indirect evidence. As Exhibit C produced only a nonhuman incisor it will not be discussed further. Exhibit G produced a minimum of one adult of unknown sex, while Exhibit H produced one female over 50 years of age and one adult mandible.

Exhibit I could not be associated with any known site and contained no artifactual material. The absence of adult crania prevented the use of craniometrics for the determination of ethnic affiliation.

In summary, of the minimum number of 16 individuals five (Exhibits E and I) are of unknown ethnic affiliation, three (Exhibit A) assigned to a mixed Arikara-Mandan heritage, five (Exhibits B and F) are assigned to the Arikara, and three (Exhibits G and H) to the Mandan/Hidatsa. Although the small sample size prevented the use of nonmetric traits for determining genetic affiliation, the trait frequencies for Exhibits A, F, and H are reported in Table 22.

Demographic analysis is limited by the fragmentary nature of the skeletal remains, their derivation from seven archeological sites, and their assignment to four categories of ethnic affiliation (Table 23). The most remarkable anomaly of the demographic distribution is the virtual absence of children, which can be explained by the recovery circumstances. In each case, the skeletons were exposed by erosion which is likely to destroy or remove any subadult remains. The total sex ratio is approximately normal with four males, five females, and seven unknowns. Each exhibit producing more than one individual produced both males and females. Although the demographic data can not be used to estimate adaptive efficiency, the data do suggest the absence of systematic demographic bias. One interesting observation is the presence of splintered long bones in Exhibit I, which is suggestive of Plains warfare (Owsley et al. 1977; Zimmerman et al. 1981). Forty percent of the 15 long bones from this exhibit are splintered. The high frequency of splintering and the large number (i.e., four) of possibly comingled individuals from Exhibit I suggest that this collection may have resulted from conflict.

The paleopathology of the sixteen individuals is organized by cultural affiliation. The four individuals of unknown ethnic identity from Exhibit I produced the lowest frequency of gross pathologies. None of the three adults produced any evidence of infectious lesions or degenerative joint disease.

The five year old child displayed mild cribra orbitalia which might indicate iron deficiency anemia resulting from a moderate to high maize consumption (El-Najjar et al. 1976; Lallo et al. 1977), although iron deficiency anemia is frequently the consequence of childhood infections (Mensforth et al. 1978). Consequently, a single case of porotic hyperostosis is not necessarily indicative of maize consumption. The absence of cultural and temporal data makes any comparison to other collections virtually meaningless.

All three adult individuals of mixed Arikara-Mandan affiliation from Exhibit A are characterized by degenerative arthritis of all observable joint systems. No evidence of infectious disease was observed.

The two Mandan individuals from Exhibits G and H are characterized by degenerative arthritis of the major joint systems, while the female from Exhibit H also has spinal osteophytosis. This female also suffered from senile osteoporosis and an inflammatory joint disease which could be diagnosed as joint tuberculosis or adult rheumatoid arthritis among other specific diseases. Again no evidence of periosteal inflammation was observed.

The five Arikara individuals from Exhibits B and F are relatively free of pathologies. Individual 3 from Exhibit B has spina bifida (a congenital defect) and degenerative arthritis of the major joints, while the young female from Exhibit F shows only cranial deformation caused by premature suture closure. Again no periosteal inflammation was evidenced.

Although infectious osseous lesions (i.e., periostitis and osteomyelitis) are found among the historic Arikara, these lesions are not reported as either common or severe (Bass 1964; Bass et al. 1971; Hughey 1980; Zimmerman et al. 1981). In contrast, the Arikara were frequently victims of degenerative arthritis of the major joint systems and spinal osteophytosis (Bass 1964; Hughey 1980; Zimmerman et al. 1981). In contrast earlier skeletal series, such as those from the Sonota Complex (A.D. 90-610, Neuman 1975), are characterized by moderately high infection rates and relatively low arthritis rates (Bass and Phenice 1975). For example, the Grover Hand site has a 38.5% tibial periostitis rate with some arthritic lesions (Bass and Phenice 1975). There is little comparative data for the Mandan, although it is doubtful that they differ significantly from the Arikara.

These small sample sizes preclude statistical analysis, but anecdotal comparison indicates that both the Mandan (Exhibits G and H) and Arikara (Exhibits B and F) skeletal series are comparable to the Arikara series reported in the literature. Both are characterized by low infection rates and moderate arthritis rates. In contrast, the mixed Arikara-Mandan individuals from Exhibit A and the unknown group from Exhibit I differ from the historic Arikara in the first case by a high (100%) arthritis rate and in the second by a low adult (0%) disease rate.

Recent research has demonstrated the utlity of enamel hypoplasia analysis for the reconstruction of childhood stress patterns (Cook 1981; Goodman et al. 1980; Rose et al. 1978). Since each tooth crown is formed during a specific chronological period during childhood, any enamel hypoplasia observed on the adult dentition can be assigned to a specific age (i.e., 2.5-3.0 years). Thus the chronological distribution of enamel hypoplasias can be used to reconstruct the childhood stress pattern. Similarly, growth arrest lines (Harris lines) observed in radiographs of adult long bones can be used to reconstruct childhood stress (Clarke 1982; Steinbock 1976).

Analysis of enamel hypoplasias was hampered by the absence of teeth in all but four exhibits, and even here the teeth had either been lost (Exhibit H, Individual 1) or all the enamel had been removed by wear (Exhibit A). Both the unknown group (Exhibit I) and the Mandan (Exhibit H, Individual 2) had observable enamel and no hypoplasias. In contrast, the young Arikara female from Exhibit F had two stress episodes: 1) 2.5-3.0 years; and 2) 3.5-4.0 years. The presence of these stress episodes among the historic Arikara is consistant with the high childhood mortality and stress levels of the historic Arikara (Owsley and Bass 1979). A total of six intact tibiae from Exhibits B, F, and H were radiographed and examined for growth arrest lines. In no case did a line meet the criteria of extending at least three-quarters of the way across the medullary cavity. It is possible that the sand within the medullary cavities of all tibiae obscured lines that were present.

The reconstruction of diet for the Multicounty specimens is hampered by the virtual absence of teeth and other data sources. The only dietary indicator from Exhibit I, representing the unknown group, is the presence of cribra orbitalia on the five year old cranium. As mentioned previously, this lesion can be interpreted as evidence for a maize diet or the consequence of childhood infection. Cribra orbitalia and porotic hyperostosis, both indicative of iron deficiency anemia, are not uncommon among the maize consuming Arikara (Gregg et al. 1981; Zimmerman et al. 1981). However, without additional data from Exhibit I, no conclusions can be drawn from the presence of a single lesion. The partial dentition from Exhibit A representing the mixed Mandan-Arikara group does provide some dietary information. Tooth wear is extreme with molar Murphy scores ranging from five to nine (Table 4). The S.E.M. micrographs of this exhibit indicate a coarse abrasive diet and the use of stone food preparation implements (Plates 3-8). No caries are observable on these teeth primarily due to the extreme dental attrition. The Arikara are characterized as showing heavy dental attrition and a moderate caries rate (i.e., 2 caries per individual) (Bass et al. 1971; Hughey 1980), which is comparable to other societies using stone implements to process maize (Rose et al. 1982). These limited data suggest that the individuals represented by Exhibit A were utilizing a diet similar to the historic Arikara.

The Arikara dentition from Exhibit F differs from Exhibit A in the presence of one carie (1 carie per 4 teeth) and very light dental attrition (Murphy scores of 0). In addition, the S.E.M. micrographs indicate the consumption of nuts or other small hard unprocessed seeds (Plates 40-42). The low attrition scores can be partly attributed to the young age of the Exhibit F female, as can the one carie (has not yet been removed by attrition). The consumption of nuts and the virtual absence of striations is in distinct contrast to the Exhibit A diet. These differences could represent different cultural adaptations or simply reflect seasonal variation. No further discussion is possible without additional data or comparative material.

During the analysis of the postcranial measurements it was noticed that the femoral torsion angles for Individual 1 Exhibit B (Plate 31, Table 9) are asymmetrical. Femoral torsion (the measurement of the angle of the head and neck to the shaft, after Steindler 1970) influences the skeletomuscular relationship of the femur and pelvis, as well as the angle of the knee and hence the foot to the midsagital plane. There are no clinical standards of normal torsion established which would suggest that this individual is abnormal, but in the experience of the authors the torsion angles are usually symmetrical between the right and left femora. This young Arikara female displays greatly divergent angles, specifically 10^{0} for the left (retroversion) and $39^{0}$for the right (anteversion). These angles can be compared to the mean angles obtained from the prehistoric American Indian Dickson Mound Illinois sample: 15.2^{0} (S.D. 8.14^{0}), males; and 20.5^{0} (S.D. 9.32^{0}), females (VanGerven 1971). The left femur of Individual 1 is one standard deviation below the female mean and the right is two standard deviations above the female mean. In a relaxed standing posture this woman's right foot would have been oriented straight forward and the the left foot would have been turned to the side (laterally). The abnormal angles in conjunction with the total femoral head and neck morphology suggests a tentative diagnosis of subclinical coxa vara (left) and coxa vulga (right).

An association is postulated between the abnormal thinning or localized osteoporosis of the ilia of Individual 1 and the presence of coxa vara. The osteoporotic areas of the ilium are the origin points of the gluteus medius and gluteus minimus, both prime abductors. Both coxa vara and coxa vulga with the accompanying anteversion contribute to a reduction in normal abduction of the leg (Steindler 1970). In coxa vara the greater trochanter (insertion point of gluteus medius and minimus) is moved upward placing these prime movers under less than normal mechanical stress (Steindler 1970). In coxa vulga the greater trochanter is brought more forward (anteriorly) and closer to the pelvis also reducing mechanical stress (Steindler 1970). This reduction in stress could produce the observed osteoporosis and abnormal iliac morphology observed in Individuals 1, 2, and 3 from Exhibit B.

Individual 2 Exhibit B (sex?, 17-19 years) has unfused femora (which could not be measured) which visually display retroversion of the left and anteversion of the right femora (Plate 32). Individual 3 has a low torsion angle (13^{o}) of the left femur, but the absence of the right prevents determination of asymmetry. Another young Arikara female (Exhibit F) has a right femur with a high torsion angle (32^{o}) which is similar to Individual 1 Exhibit B, but absence of the left precludes determination of asymmetry. The elderly Mandan female from Exhibit H also displays asymmetry with a left angle of 17^{o} and a right angle of 33^{o}. The adult Mandan from Exhibit G has a left femoral torsion angle of 17^{o}, but no right femur. None of the femora from Exhibits A and

I are sufficiently preserved for measurement, but visual observation suggests retroversion of the left femora and anteversion of the right femur from Exhibit I. In summary, although there are femoral pairs only from Individuals 1 and 2 from Exhibit B and the female from Exhibit H, all other femora appear to be consistent with the pattern of retroversion of the left and anteversion of the right femora.

Only one reference to coxa vara could be found in the paleopathology literature (Hershkovitz et al. 1982). These three cases from a Chalcolithic sample from the Sinai are all from a single family grave which suggests a diagnosis of inherited congenital coxa vara (Hershkovitz et al. 1982). Bass and Barlow (1964) report asymmetrical femoral torsion angles of 5^{o} for the left and 60^{o} for the right from a prehistoric Crow female skeleton found at the Pryor Creek site (24 YL 404) in Montana. The widespread geographical distribution (Montana and Lake Oahe North Dakota) of asymmetrical femoral torsion suggests that this condition is developmental and not genetic. Coxa vara, coxa vulga, and abnormal femoral torsion are attributed to a number of causes including congenital defect, paralysis, rachitis, osteomalacia, and traumatic hip dislocation (Steindler 1970). At present the best causal explanation for this phenomenon is developmental resulting from habitual body positioning during sleep or daily task performance.

Examination of the patterning of femoral torsion asymmetry does not reveal any simple trends. The phenomenon is found among the Arikara (Exhibit B), the Mandan (Exhibit H), and the Crow (Bass and Barlow 1964). Although asymmetry can only be metrically documented among females (Exhibits B and H; Bass and Barlow 1964), there is the possibility of its presence in males (Individual 3, Exhibit B; Individual 1, Exhibit I). Any further speculation concerning the cause of asymmetrical femoral torsion must await analysis of large Plains skeletal series.

RECOMMENDATIONS

Shoreline erosion, subsequent exposure and destruction of archeological remains are facts of life for the Federal impoundments in the Dakotas. These conditions have created a dilemma which the Government, the professional community of anthropologists, and the public now face: How should these vestiges of past Indian culture be protected or, if this proves impossible, documented and sampled once exposed along a lake shore?

The nine exhibits described in the preceding sections, if nothing else, illustrate the magnitude of this problem. For on one hand, the remains often are either found or vandalized by the general public while, on the other hand, their eventual retrieval ideally requires trained personnel who are capable of evaluating the context of a discovery and systematically recording or salvaging it. In this respect, human burials or skeletal remains are among the more prominent and important materials which may be salvaged. But their heuristic potential depends to a large degree on a proper understanding of burial or skeletal context. To what extent can a burial or isolated human bones be keyed to a cultural group and time period is an essential question.

A related issue which these exhibits also underscore is the unplanned nature of discovery. It is analogous to putting out isolated brush fires while the forest burns.

Considering these facts, our recommendations are:

1. That the public lake users be brought into the process of protecting and notifying appropriate State and Federal officers about endangered archeological remains. The greatest service which could be provided in this respect is prompt notification <u>without</u> further movement of materials, and marking the area of a discovery.

2. That enforcement of Federal antiquities laws which protect archeological remains within Federally owned lands be actively pursued. This should be done by public notice of penalties ranging from fines to jail terms for destruction or tampering with Indian remains. These notices of key provisions should be posted prominently at lake access points and at known archeological sites. A second aspect of this program is that violators should be arrested and prosecuted to the full extent the law allows, and the results of trials and convictions be publicized.

3. Systematic reconnaissance of known archeological sites along lake shores should be done on a regular basis by project personnel. These individuals need not be professional archeologists, but at least should be able to recognize artifacts and human skeletal material when they see them. Their role should be one of primarily identifying locations of human remains which require salvage so that salvage efforts can be undertaken quickly.

4. Salvage of human skeletal remains should be done by an archeologist. Under most conditions, the salvage procedure should: (a) be documented by photography; (b) include use of graphic recording of the disposition of skeletal elements and probable associated artifacts; (c) entail the individual labeling of bones and artifacts in the field to assist laboratory analysis and curating; and (d) require that the salvage location be ascertained accurately in terms of topography, lake level, and legal description. Depending on favorable conditions in terms of both weather and burial context, screening of burial matrix through a small and known mesh size should be a standard procedure. Additional sediment samples should be retained for laboratory analysis which come from abdominal cavity or other pertinent areas as determined in the field.

Specific recommendations for further work are made for the following exhibits:

1. The excellent state of preservation and the proximity of Exhibits B and F suggest the possibility of a large Arikara cemetery in this location. Additional testing is recommended.

2. The possibility that Exhibit I represents the site of intergroup conflict also recommends this location for additional testing.

APPENDIX I

PLATES

Plate 1. Humerus head (XA 91) showing degenerative arthritis.

Plate 2. Inferior view of cranium (XA 160-4) showing alveolar resorption and extensive dental attrition.

Plate 3. Occlusal view of mandible (XA 160-3) showing extensive dental attrition and exposure of pulp chamber (arrow).

AD-A129 498 ANALYSIS OF HUMAN OSTEOLOGICAL REMAINS MULTI-COUNTY AREAS NORTH DAKOTA(U) ARKANSAS UNIV FAYETTEVILLE DEPT OF ANTHROPOLOGY J C ROSE ET AL. MAR 83 2/2

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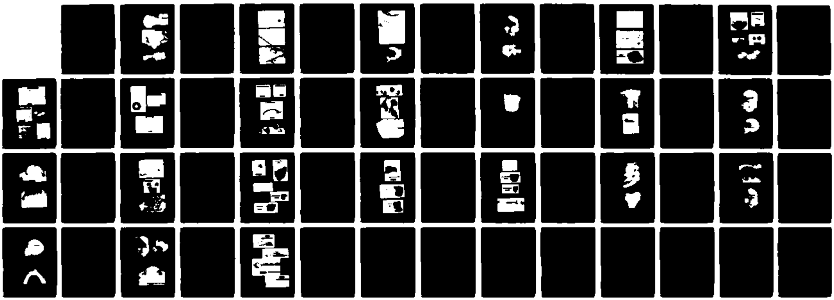

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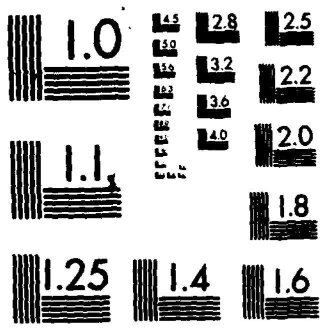

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Plate 4. S.E.M. micrograph of right third maxillary molar showing extensive striations and absence of compression fractures (19x) (XA 160-4).

Plate 5. S.E.M. micrograph of molar illustrated in Plate 4 showing artificial striations (1500x) (XA 160-4).

Plate 6. S.E.M. micrograph of molar illustrated in Plate 4 showing numerous large sharp striations in cross-hatch pattern (1500x) (XA 160-4).

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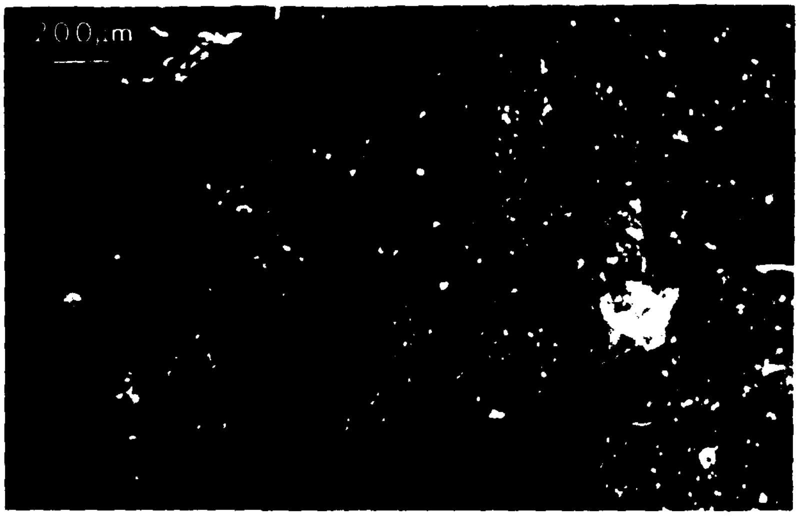

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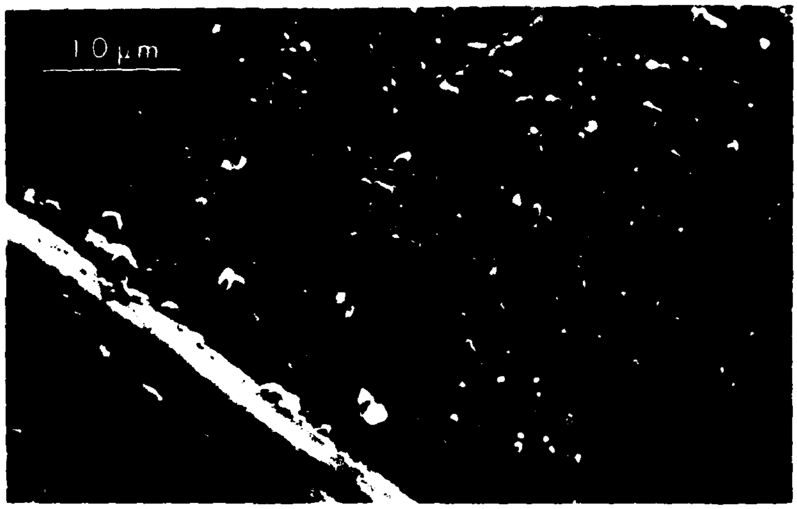

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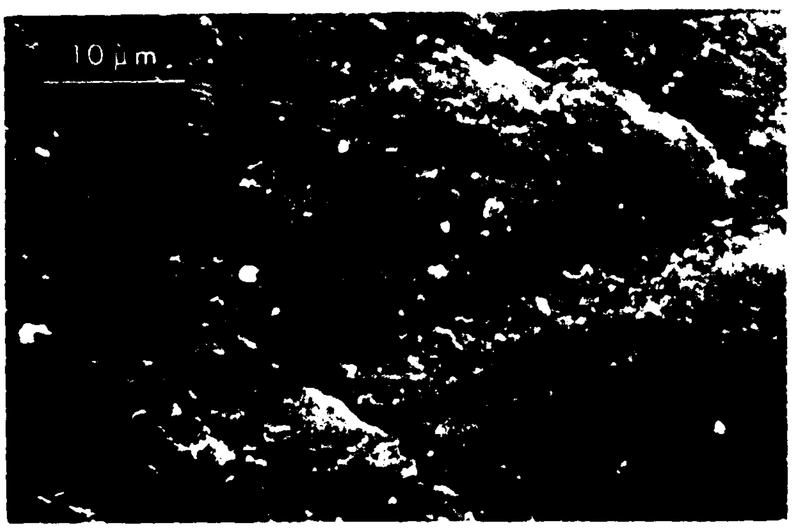

Plate 7. S.E.M. micrograph of mandibular second molar showing enamel rim (e) and dentin (d) with large striations (20x) (XA 160-3).

Plate 8. S.E.M. micrograph of molar illustrated in Plate 6 showing large striations in a cross-hatch pattern (1500x) (XA 160-3).

Plate 9. Lateral view of cranium (XA 160-4).

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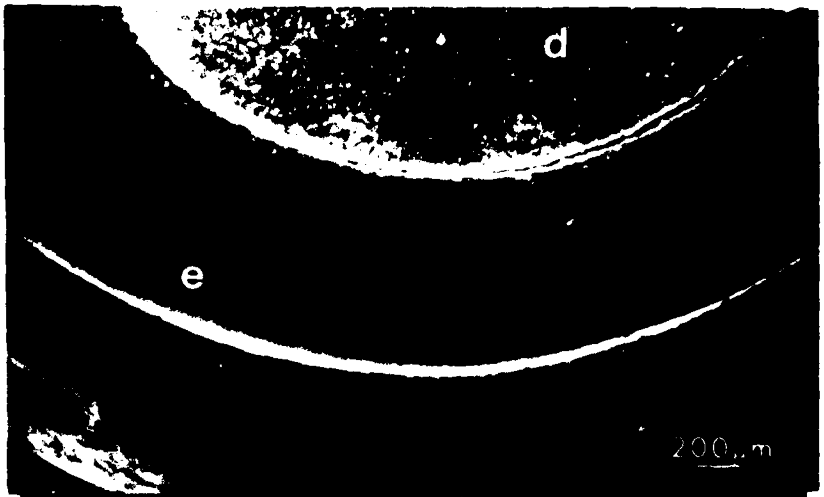

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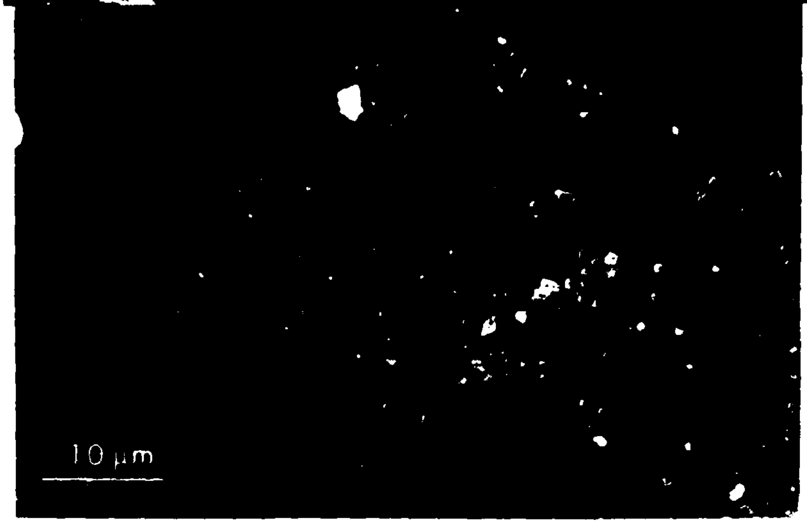

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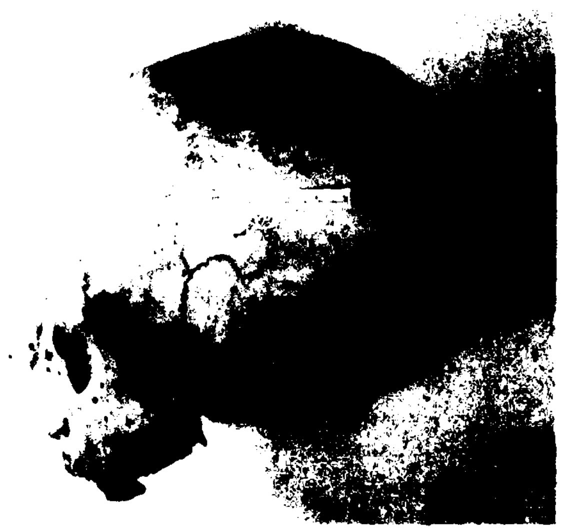

Plate 10. Frontal view of cranium (XA 160-4).

Plate 11. Thoracic 12 vertebra showing collapse due to herniated disc (XA 160).

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Plate 12. Winona Island skeletal material with concentration one under logs and concentration two in foreground (Photograph by Robson, courtesy Omaha District U.S. Army Corps of Engineers).

Plate 13. Winona Island skeletal material from concentration one (Photograph by Robson, courtesy U.S. Army Corps of Engineers).

Plate 14. Biface of Knife River Flint.

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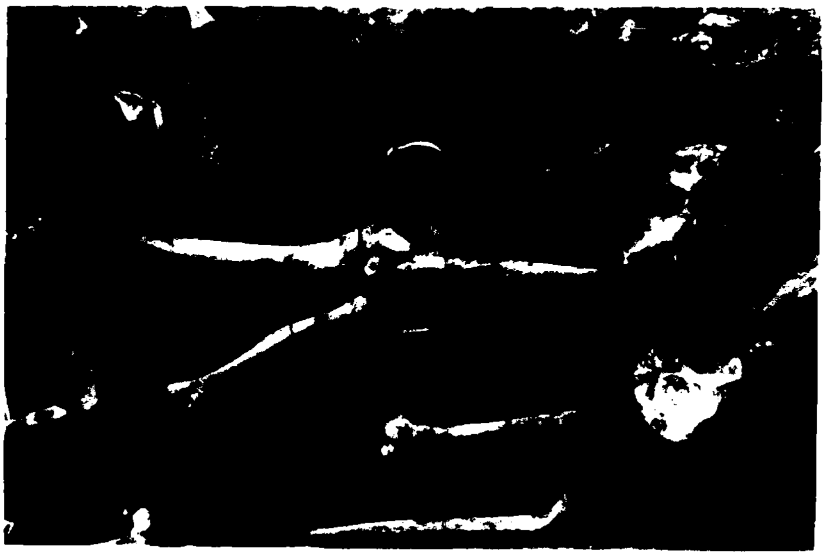

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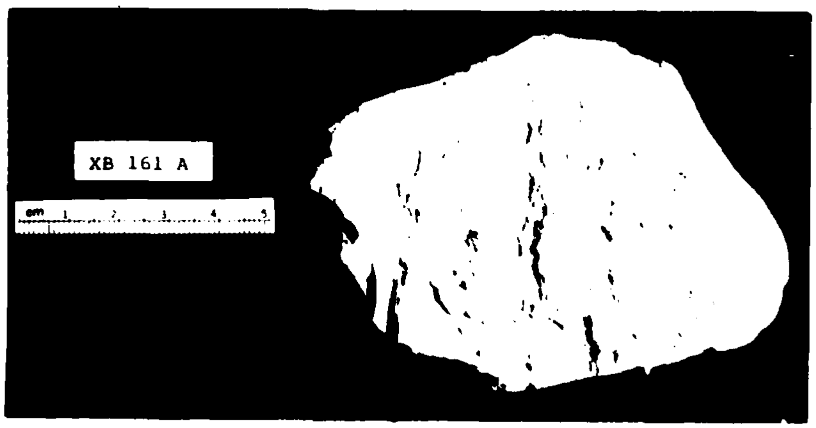

Plate 15. Biface of Knife River Flint.

Plate 16. Flake of Tongue River Silicified Sediment.

Plate 17. Simple stamped body sherd.

Plate 18. Two circular milk glass buttons.

Plate 19. Four fragments of an iron plate.

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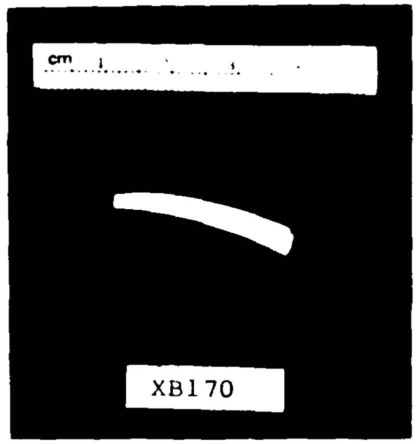

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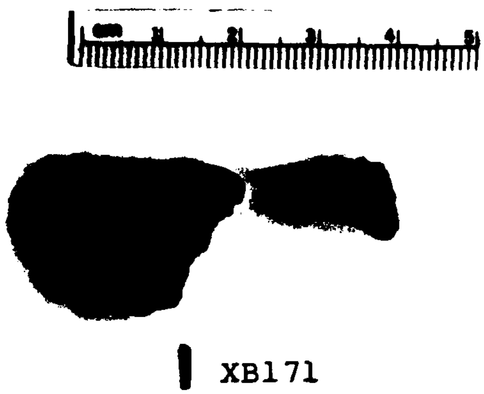

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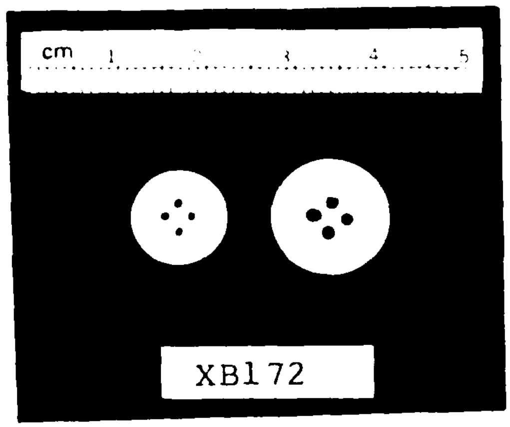

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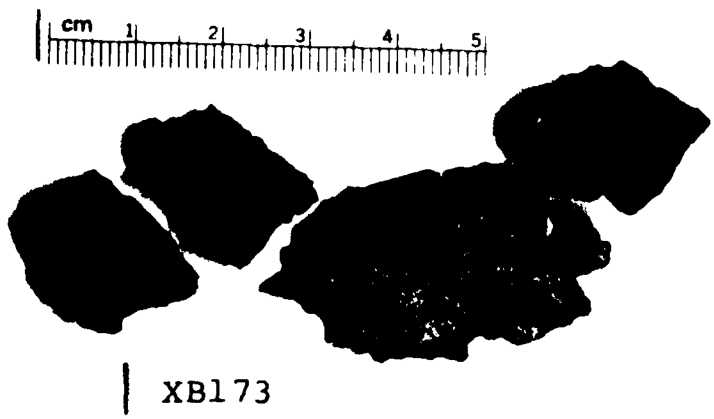

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Plate 20. Nine rectangular headed nails.

Plate 21. Iron harness buckle.

Plate 22. Two white spun glass seed beads.

Plate 23. Six turquoise green spun glass beads.

Plate 24. Four indigo blue spun glass seed beads.

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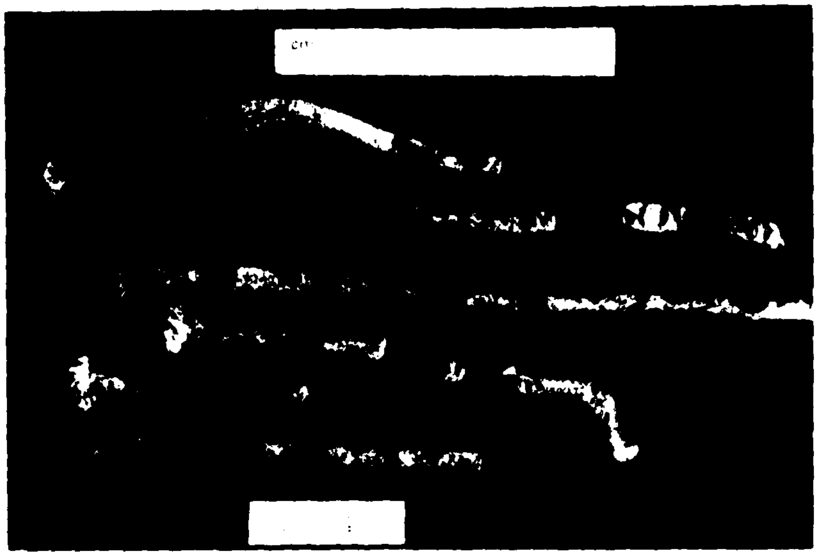

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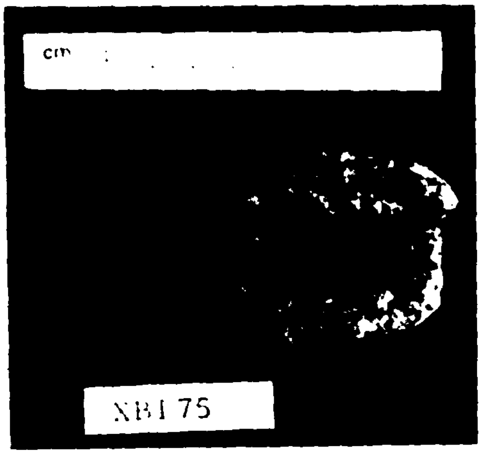

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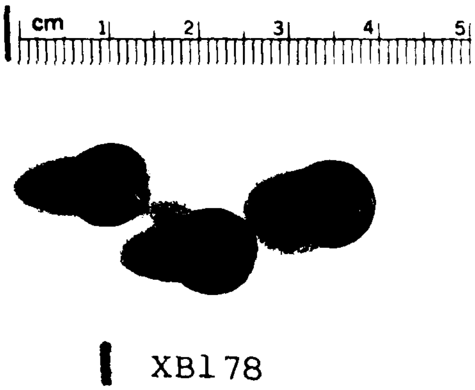

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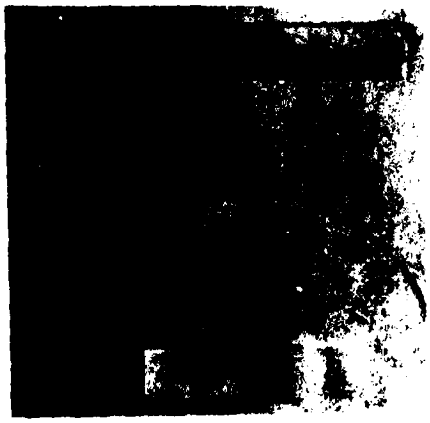

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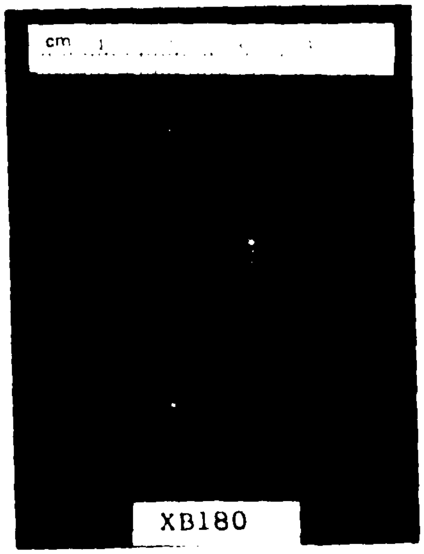
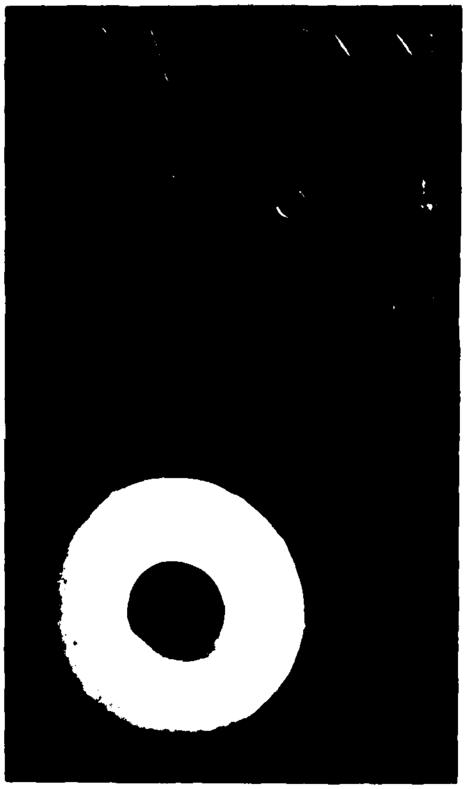


Plate 25. One yellow spun glass seed bead.

Plate 26. Sixteen pink spun glass seed beads.

Plate 27. Two hundred and sixty two turquoise blue glass seed beads.



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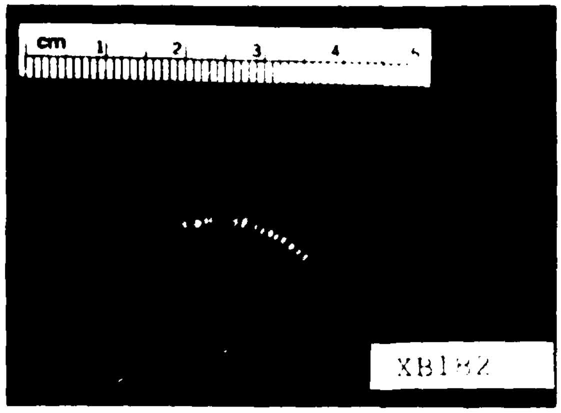

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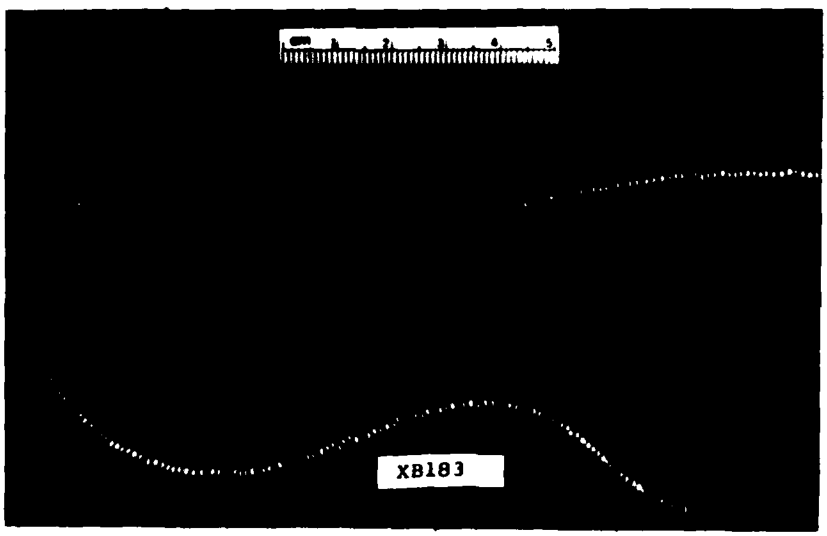

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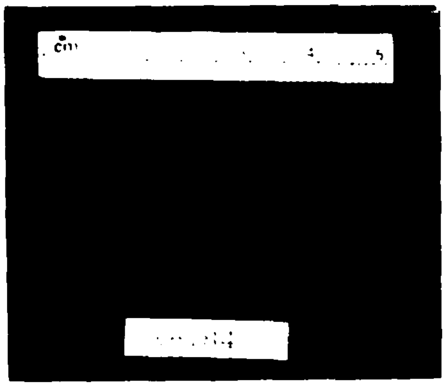
Plate 28. Ten royal blue glass seed beads.

Plate 29. Twenty one white spun glass seed beads.

Plate 30. White glaze ceramic handle.

Plate 31. Two femora from Exhibit B Individual 1 showing extreme retroversion of the right femur (XB1 38C) and anteversion of the left (XB1 38D).



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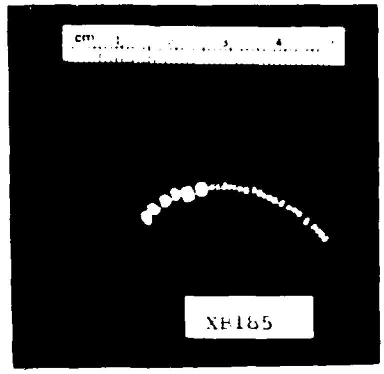

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Plate 32. Two femora from Exhibit B Individual 2 showing extreme retroversion of the right femur (XB1 39C) and anteversion of the left (XB1 39D).

Plate 33. Right innominate of Exhibit B Individual 3 showing abnormally concave iliac fossa (XB1 40E).

Plate 34. *Sacrum from* Exhibit B Individual 3 showing irregularity of promontory (XB3 40F).

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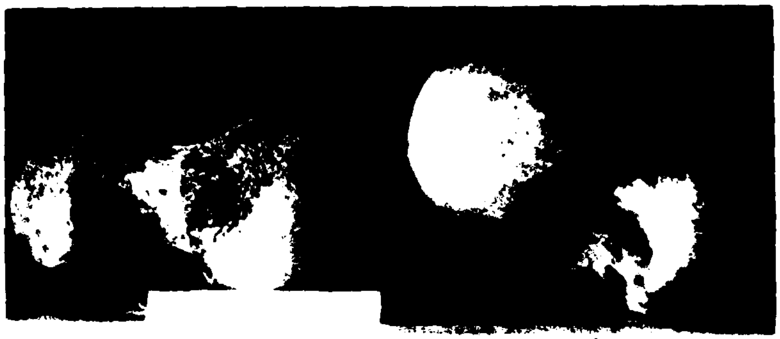

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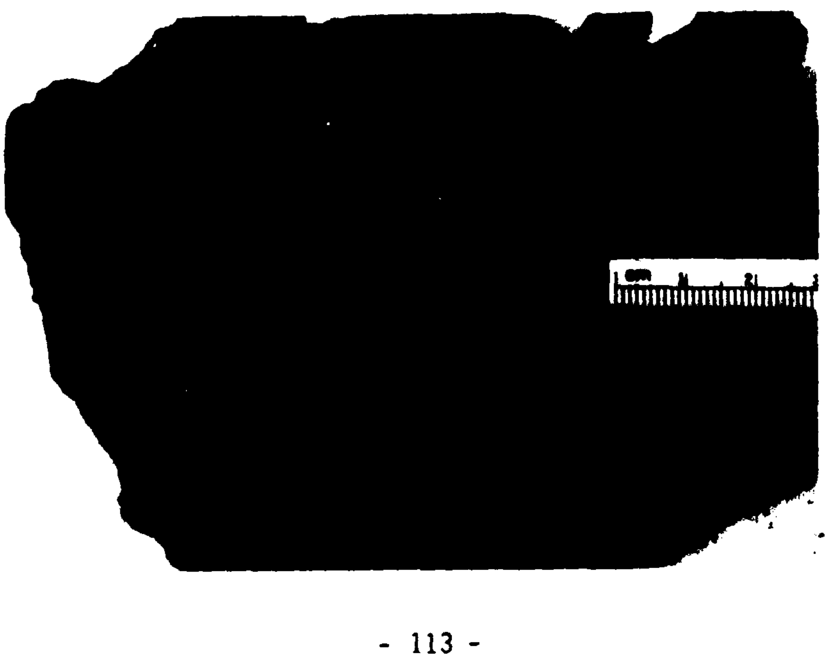

Plate 35. Sacrum from Exhibit B Individual 3 showing partial spina fibida (XB3 40F).

35

Plate 36. Left femur (XB1 40H) and left tibia (XB1 40I) of Exhibit B Individual 3 showing degenerative lesions of the knee joint and gastrocnemial reaction (arrow).

Plate 37. Basalt hammerstone from Exhibit D (XD 60).

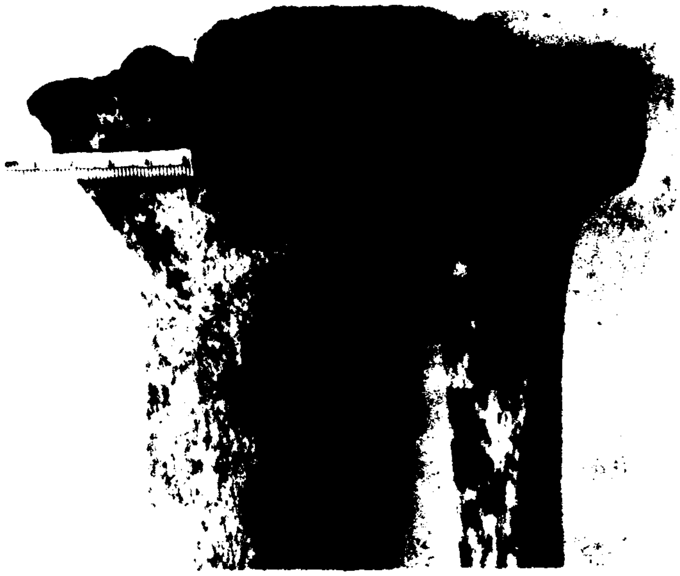

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Plate 38. Frontal view of cranium (XF 79) showing asymmetry.

Plate 39. Left lateral view of cranium (XF 79).

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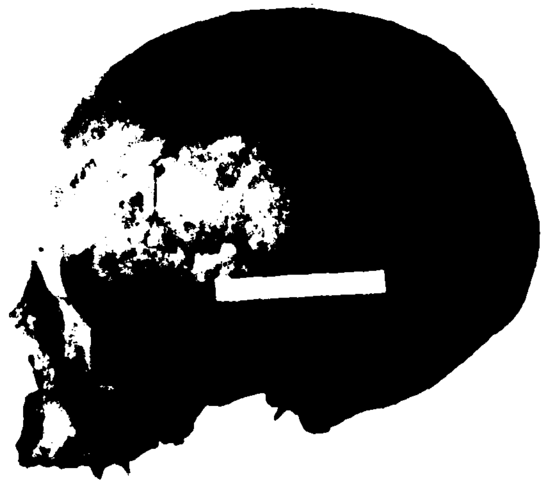
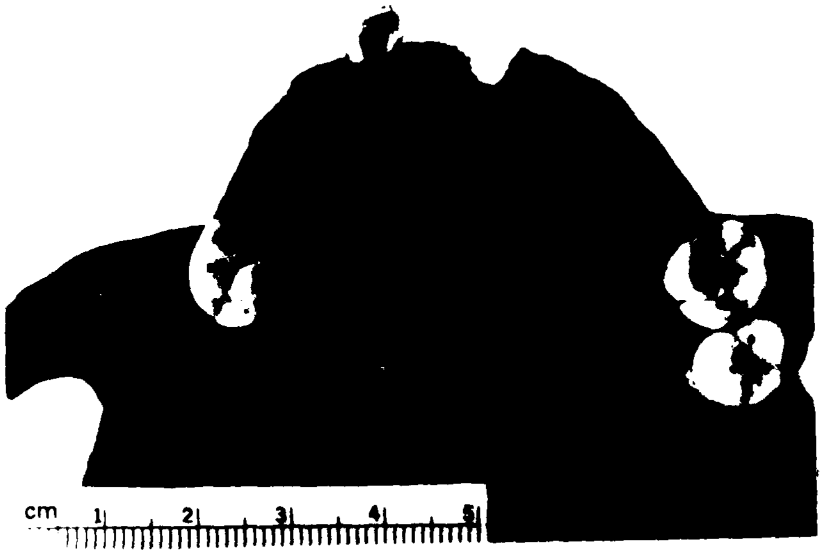


39

Plate 40. Maxillary dentition of XF 79 showing slight dental attrition.

Plate 41. S.E.M. micrograph of left first maxillary molar showing heavily pitted enamel surface (XF 79) (19x).



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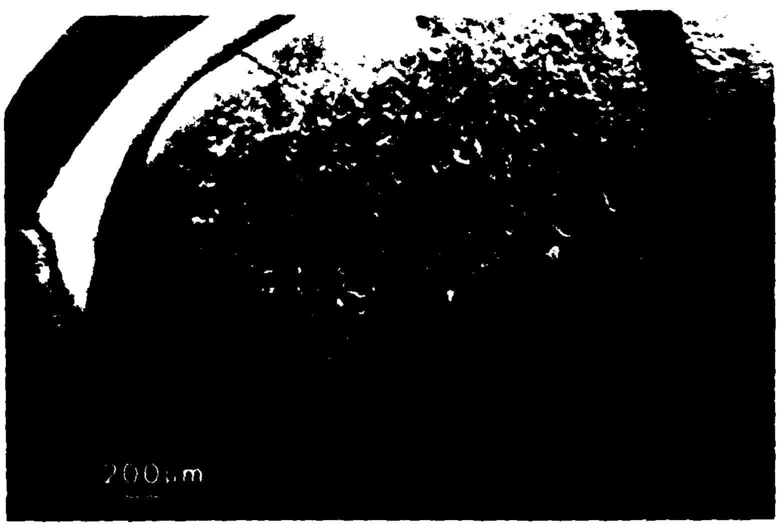

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Plate 42. S.E.M. micrograph of the same tooth illustrated in Plate 41 showing absence of striations and extent of pitting (1500x).

Plate 43. Posterior view of distal femur (XG 45) showing degenerative arthritis of the knee joint.

Plate 44. Individual one from Exhibit H just prior to recovery.

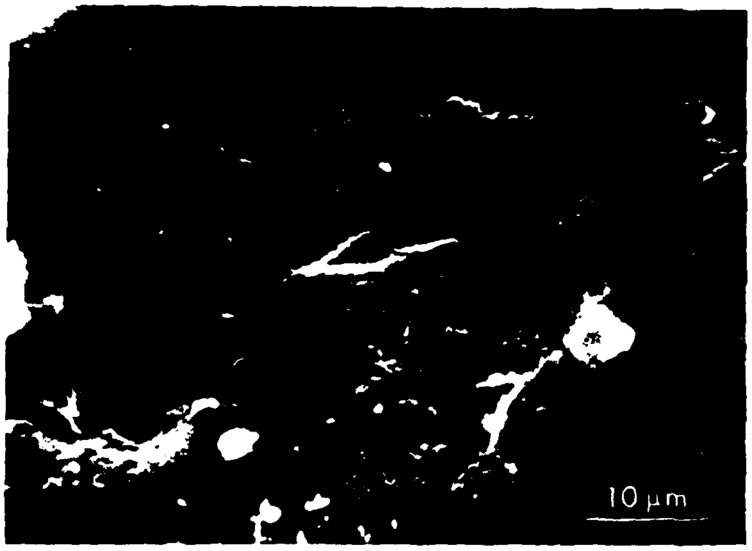

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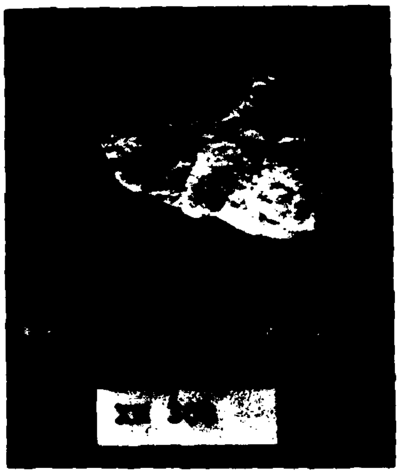
Plate 45. Distal biface fragment of Tongue River Silicified Sediment (XH 308).

Plate 46. Scorea or clinker, possibly ground (XH 309).

Plate 47. Animal bone scapula squash knife (XH 310).

Plate 48. Trailed body sherd (XH 312).

Plate 49. Plain rim sherd, serrated lip (XH 317).



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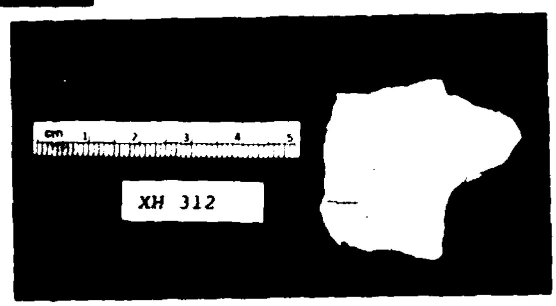

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Plate 50. Plain rim sherd (XH 318).

Plate 51. Smoothed overtrailed rim sherd, raised lip on interior (XH 319).

Plate 52. Rim sherd, horizontal cord wrapped stick impressed (XH 320).

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Plate 53. Rim sherd, horizontal cord impressed (XH 321).

Plate 54. Rim sherd, vertical linear incised lip (XH 322).

Plate 55. Rim sherd, vertical fingernail impressed lip (XH 323).

Plate 56. Distal humeri (XH 293, XH 294) of Individual 1 Exhibit H showing destructive inflammatory lesions of the articular surfaces.

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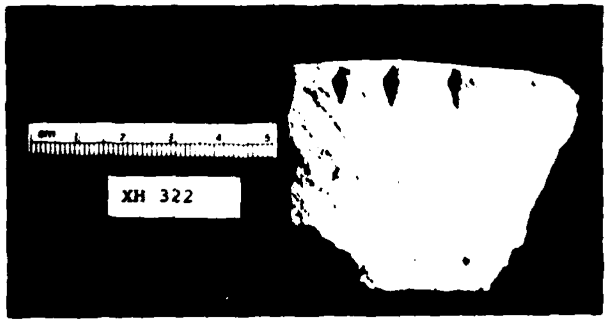

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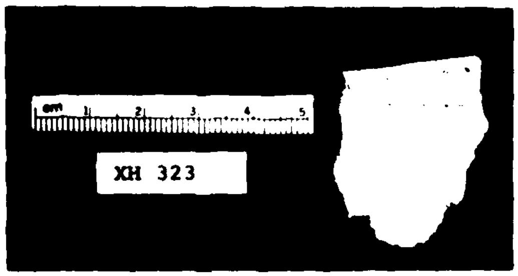

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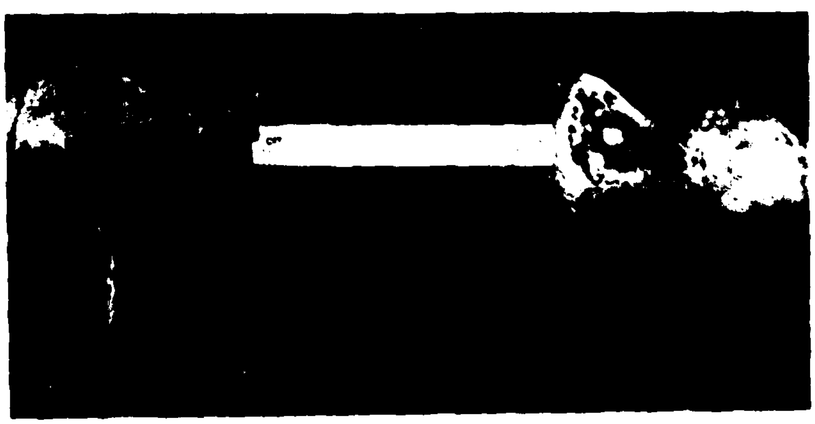

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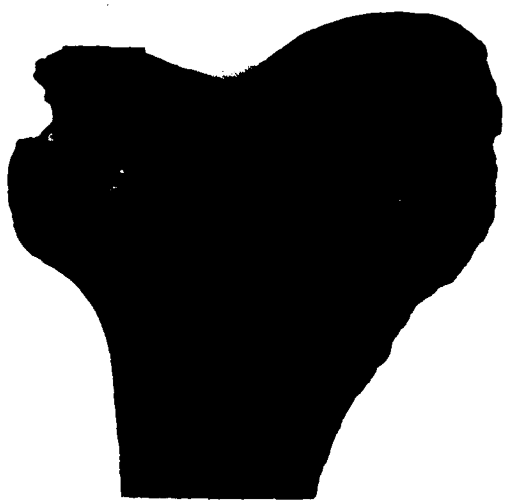
Plate 57. Lateral view of vertebrae (XH 295 - 299) from Individual 1 Exhibit H showing absence of neural arch of fifth lumbar vertebra.

Plate 58. Posterior view of the right femur (XH 307) from Individual 1 Exhibit H showing progressive destruction of the lateral condyle.

57

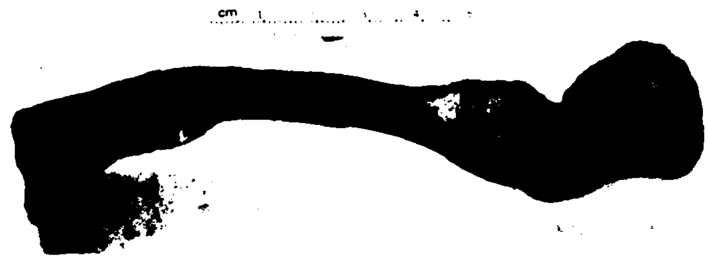


58

Plate 59. Clavicle (XH 248) of Individual 1 Exhibit H showing osseous proliferation characteristic of degenerative arthritis.

Plate 60. Superior view of femora (XH 303, XH 307) from Individual 1 Exhibit H showing asymmetrical torsion.

Plate 61. Frontal view of cranium from Individual 1 Exhibit H (XH 243).



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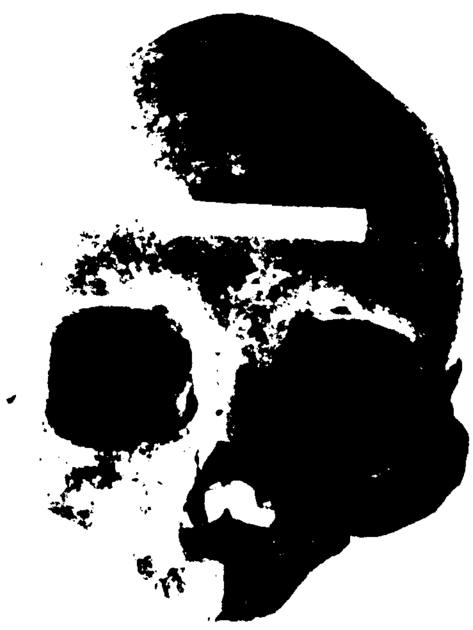

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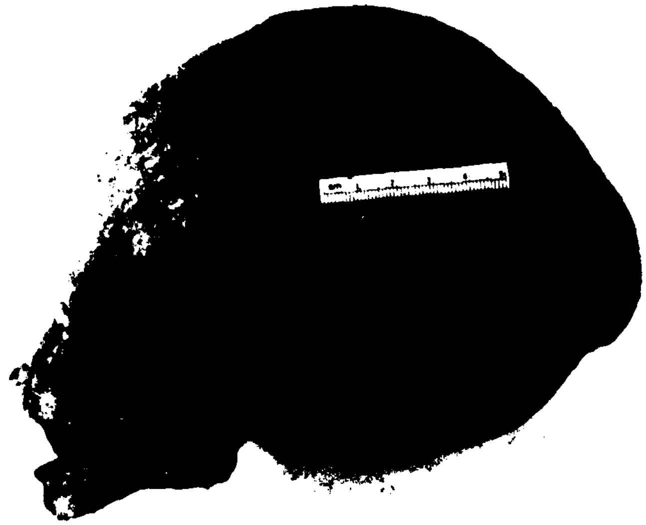
Plate 62. Lateral view of cranium from Individual 1 Exhibit H (XH 243).

Plate 63. Superior view of mandible (XH 241) from Individual 2 Exhibit H.



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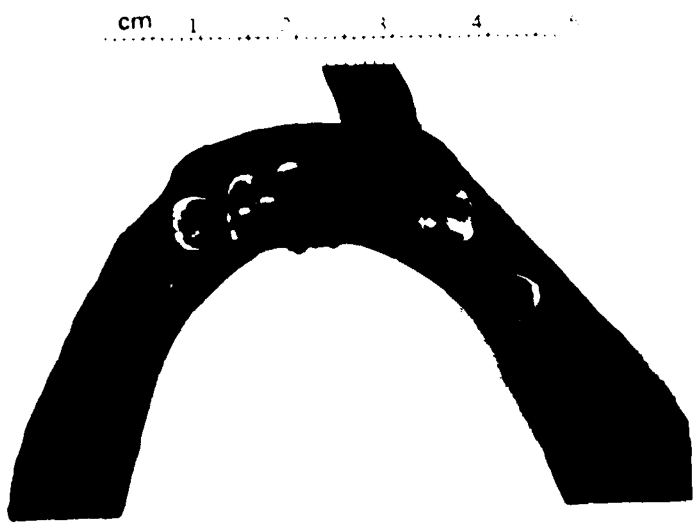

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Plate 64. Frontal view of juvenile cranium from Exhibit I (XI 234).

Plage 65. Lateral view of juvenile cranium from Exhibit I (XI 234).

Plate 66. Occlusal view of the dentition from the juvenile cranium from I (XI 234).

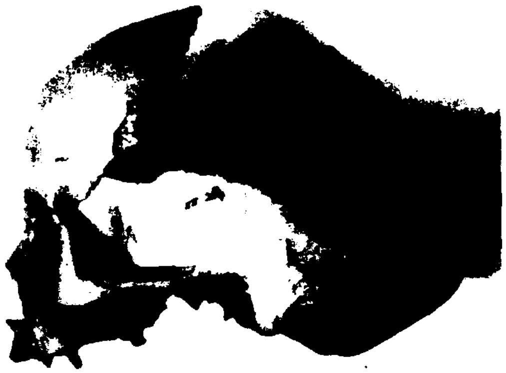

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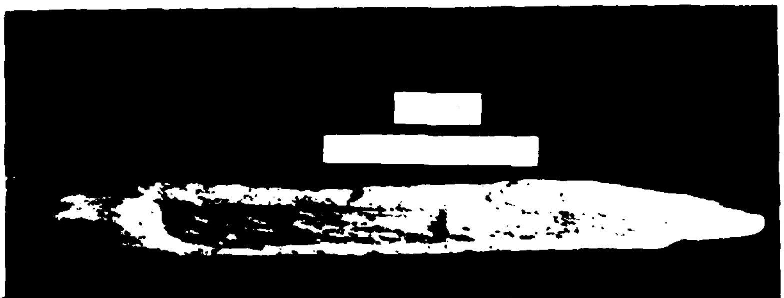
Plate 67. Right humerus shaft exhibiting splintering (XI 187).

Plate 68. Right tibia exhibiting splintering and possible use as tool (XI 188).

Plate 69. Proximal tibia exhibiting splintering and possible use as tool (XI 200).

Plate 70. Left ulna exhibiting splintering (XI 203).

67



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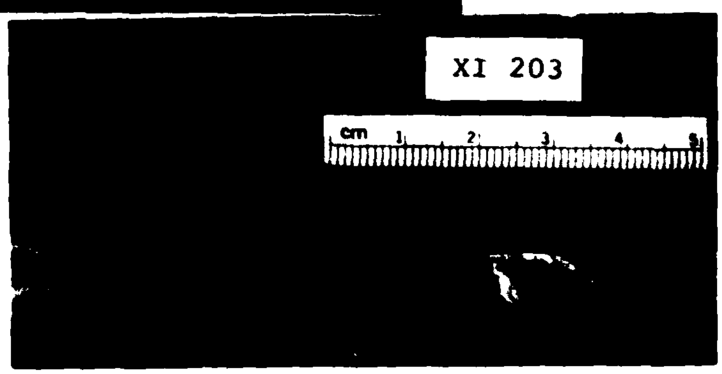

APPENDIX II

List of 35mm Color Slides, Available from Omaha District Office of U.S. Army Corps of Engineers

Exhibit B

1. XB 183, Beads
2. XB 182, Beads
3. XB 181, Beads
4. XB 179, Beads
5. XB 184, Beads
6. XB 185, Beads
7. XB 180, Beads
8. XB 177, Beads
9. XB 178, Beads
10. XB 170, Bead
11. XB 172, Buttons
12. XB 176, Musket Ball
13. XB 174, 9 Iron Nails
14. XB 175, Iron Buckle
15. XB 173, Iron Plate
16. XB 185-1, Porcelain Handle
17. XB 171, Sherd
18. XB 161C, Lithic Artifact
19. XB 163A, Lithic Artifact
20. XB 161A, Lithic Artifact
21. XB-1 38C, D, Femoral Torsion of Individual 1
22. XB-1 40G, 40H, 40I, XB-3 40F, Degenerative Arthritis of Individual 3

Exhibit A

23. XA 160-4, Frontal View of Cranium
24. XA 160-4, Basilar View of Cranium
25. XA 160-4, Lateral View of Cranium

Exhibit D

26. XD 61B, Lithic Artifact
27. XD 60, Lithic Artifact

Exhibit F

28. XF 79, Frontal View of Cranium
29. XF 79, Lateral View of Cranium
30. XF 79, Occipital View of Cranium
31. XF 79, Basilar View of Cranium
32. XF 79, Occipital View of Cranium
33. XF 79, Occipital View - Close Up of Cranium
34. XF 79, Sagital View of Cranium

List of 35mm Color Slides
(Cont.)

Exhibit H

35. XH 303, Lithic Artifact
36. XH 312, Sherd
37. XH 323, Sherd
38. XH 321, Sherd
39. XH 309, Lithic Artifact
40. XH 318, Sherd
41. XH 322, Sherd
42. XH 311, Sherd
43. XH 320, Sherd
44. XH 319, Sherd
45. XH 310, Squash Knife
46. XH 317, Sherd
47. XH 243, Frontal View of Cranium, Individual 1
48. XH 243, Lateral View of Cranium, Individual 1
49. XH 243, Basilar View of Cranium, Individual 1
50. XH 290+291, Marginal Lipping of Ulnae, Individual 1
51. XH 246+248, Degenerative Arthritis of Clavicle and Sternum, Individual 1
52. XH 298, 299, Lytic Lesions, Porosity and Neural Arch Separation of the 5th Lumbar, Individual 1
53. XH 295-299, Lateral View of Lumbar Vertebrae Showing "Parrot Beak" Profile of Osteophytosis, Individual 1
54. XH 293, 294 and 307, Extensive Inflammatory Lesions of the Distal Femur and Humeri, Individual 1
55. XH 307, 303, Femoral Torsion, Individual 1
56. XH 241, Mandible, Individual 2
57. XH 241, Mandible, Individual 2

Exhibit I

58. XI 188, Tibia, Green Fracture
59. XI 187, Humerus, Green Fracture
60. XI 192, Humerus, Green Fracture
61. XI 203, Ulna, Green Fracture
62. XI 200, Tibia, Possible Tool
63. XI 201, Radius, Possible Tool
64. XI 234 Lateral View Juvenile Cranium
65. XI 234, Frontal View Juvenile Cranium

APPENDIX III

List of Material Radiographed, Available from Omaha District Office of U.S. Army Corps of Engineers

Exhibit A

Cramium XA 160-4, Lateral View
Fibula XA-90, Posterior View
Humerus XA-91, Anterior View
12th Thoracic XA-160, Lateral View
Thoracic XA-131, Lateral View
Rib XA-97, Interior View
Rib XA-141, Interior View

Exhibit B

Tibia XB-1 39E, Posterior View
Tibia XB-1 40I, Posterior View
Tibia XB-1 41A, Posterior View
Tibia XB-1 41B, Posterior View
Femur XB-1 38C, Posterior View
Femur XB-1 38D, Posterior View
Femur XB-1 40H, Posterior View
Sacrum XB-3 40F, Dorsal View
Innominate XB-1 40G, Interior View
Innominate XB-1 40E, Interior View
9 Iron Nails
1 Iron Harness Buckle

Exhibit F

Cranium XF 79, Lateral View
Cranium XF 79, Basilar View
Cranium XF 79, Frontal View
Tibia XF 77, Posterior View
Tobia XF 78, Posterior View

Exhibit H

Innominate XH 302, Interior View
Innominate XH 301, Interior View
Femur XH 303, Posterior View
Femur XH 307, Posterior View
Tibia XH 306, Posterior View
Tibia XH 304, Posterior View
Humerus XH 293, Posterior View
Humerus XH 394, Posterior View
Ulna XH 290, Lateral View
Ulna XH 291, Lateral View
Sternum XH 247
Clavicle XH 248, Inferior View
Spinal Column XH 277-299, Lateral View
Cranium XH 249, Lateral View

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